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THE UNITED STATES AND THE LEAGUE

THE NEW DELHI CONFERENCE

MANCHOUKUO'S CONSTRUCTION PROGRAM

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The United States and the League

By WILLIAM R. CASTLE, JR., Former American Under-Secretary of State in the "New York Herald Tribune"

To many people the formation of the League of Nations appeared the culmination of American efforts in favor of world peace. It was a permanent, organized body to keep the peace. There is no doubt that the Covenant was adopted at Versailles because of the determination and the driving power of President Wilson. General Smuts, of South Africa, may have had more to do with the drafting of the instrument; his ideas as to what it should contain may have been more practical; but it would never have been incorporated in the peace treaties without the enthusiasm and the insistence of the American President.

The Covenant of the League of Nations, like all international instruments, was the result of compromises. The representatives of the other nations assembled at Versailles looked at the idea with many misgivings; they adopted it because they had to, but determined to make it serve their own selfish purposes as far as possible. To France, for example, its main value appeared to be to insure the performance of the various articles of the Peace Treaty. None of the delegates except Wilson and Smuts considered the League as purely altruistic, as a truly non-partisan organization created for the purpose of bringing the nations of the world together in better understanding for the maintenance of peace. There was real enthusiasm, of course, on the part of the newly-created nations, but this was not altruism; it was selfishness, since the League, through Article X, guaranteed their frontier.

In America the idea of a League was popular enough. It appealed to those who for some time had preached in favor of a league to enforce peace, solid citizens who were determined to make future wars impossible. It seemed to those who had accepted the dictum that the great war was a war to end war, that the League of Nations was a natural sequel to the fighting. To the sentimentalists who dreamed of a family of nations living together in perpetual harmony and understanding, it was a fulfilment.

The more thinking proponents of a league to enforce peace were somewhat disillusioned by the reality as proposed, but generally accepted it as better than nothing, as at least a step in the right direction, which could be revised and improved as time went on. But the great mass of people who thought at all were inclined to be critical. Wilson had lost his leadership at home when he gained the leadership of Europe. When he returned to America his arguments sounded hollow, like pious platitudes when placed against the iniquities of the treaty which he had helped to negotiate. Political passions were aroused. The League was used as a means of attack on the President. Those who say, however, that it was politics which kept the United States out of the League are exaggerating to falsehood.

As has been pointed out in several instances, Americans are a people who run easily to extremes, who change front rapidly. The discussions in Congress, in the press and on the public platform concerning the League of Nations built up groups who took one side or the other, and took sides bitterly. The internationalists felt that for the United States to refuse to ratify the Treaty of Versailles, thus also failing to assume membership in the League, was to act the part of the traitor to peace.

The nationalists, on the other hand, pointed out clearly and with equal exaggeration that membership in the League was certain to involve us in European quarrels, was a reversal of the position which from the beginning of our history had kept the nation independent and free from the turmoil of international strife. The mistakes of the Covenant gave them plenty of ammunition. Senator Lodge was the daring and resourceful leader of the opposition. He, however, trained all his guns on Article X, which guarantees boundaries, and he even went so far as to say that the Senate, with a reservation as to this article, would accept the treaty.

Infixability of Wilson

Wilson said it must accept everything or reject everything, and it was this infixability which prevented ratification of the Treaty of Versailles and American membership in the League. Senator Lodge was right in his opposition to Article X as liable to involve the United States in European wars and therefore as contrary to tradition. Others at the time pointed out the dangers in later articles involved in economic sanctions and the agreement to join in military action against an aggressor nation; and many have since pointed out that it is utterly contrary to American policy to put in the hands of other nations the decision as to the use of American military forces—contrary not only to policy, but to the Constitution itself.

The Treaty of Versailles failed to receive the consent of the Senate to ratification and the United States remained outside the League of Nations. Communications addressed to the American government by the League were not even acknowledged during the remainder of President Wilson's term of office. He took the ground that since the United States had refused membership there must be no communication whatever with the League. When after the inauguration of President Harding, Mr. Hughes became Secretary of State, he ordered all these communications answered through the American Minister in Switzerland, and remained scrupulously polite, if somewhat aloof in his dealings with the League.

Mr. Hughes felt that merely because his government had refused membership in an organization was no reason to treat that organization as though it were a danger to this country or poisonous in itself. He began the system, since greatly developed, of co-operation with the League in matters which concerned the United States or were of humanitarian interest without political implications.

George Harvey, at that time Ambassador in London, who was one of the most violent opponents of American membership in the League, put the situation clearly and simply when he said, "If the League of Nations will go to all the trouble to organize conferences concerning subjects in which the United States is interested we should be merely boorish to refuse to send delegates. We are not afraid of the League." There has been opposition on the part of certain die-hards to any co-operation whatever; but these are men who, as George Harvey intimated, are "afraid of the League." The reasons for their fear, so long as the United States does not actually join the organization, are obscure.

The Department of State, with the approval of successive Presidents, has considered all invitations from the League, has accepted them if the subject matter was of international interest involving this country, has refused them for such definite reasons as lack of interest or adequate handling elsewhere or as contrary to American policy because dealing with political matters.

U.S. Share in Disarmament

For example, the United States has taken its full part in disarmament work, in the conferences called by the League on economic subjects, in discussions of the Far Eastern question and of Liberia, since these directly involved the United States. It has refused to participate in conferences on subjects which had no immediate interest for this country. It has seldom taken any part in the health work of the League for the reason that the International Health Office, of which America was an active member long before the League was thought of, does this work admirably, with less politics involved. The American government has never seen any reason why the League should duplicate work already being well done elsewhere. Relations with the League consist of a policy of cordial co-operation without political commitments.

With one exception this co-operation has been in conference called by the League, not in League meetings as such, where American participation would haveb een grossly improper since the United States is not a member of the club. That one exception occurred during the discussions of the Sino-Japanese controversy over Manchuria. The League of Nations had taken jurisdiction at the beginning, the United States being a keenly interested spectator only, so long as the discussions were over the terms of the League covenant. But finally the Kellogg Pact was also involved, and at that juncture the American Consul in Geneva, at the urgent request of the League, was instructed to sit with the Council, with permission to speak only when the Pact was under discussion.

This proved to be an unfortunate move. The members of the League saw in it a gesture toward American membership, and their desire to promote this object made them more interested in the physical presence of an American official than in the subject matter under discussion. At home it caused an immediate controversy. The question of whether an American sits at the Council table or on the side lines does not in the least affect the understanding necessary for co-operation or refusal to co-operate.

The American Minister to Switzerland is a man of tact and wide knowledge of foreign affairs. His informal contacts with League officials have always been satisfactory and illuminating. The League of Nations understands that the United States is not opposed to it as a body, but that it does not see its way to accepting membership so long as the Covenant contains many clauses which are contrary to American tradition and policy.

Political States in Europe

So far as Article X is concerned, with its virtual guarantee of present national boundaries, there is nothing to add to what Senator Lodge put into the record fourteen years ago. His unassailable argument was then that the United States cannot assume any responsibility for the maintenance in Europe of the political *status quo*, cannot and will not pledge the use of its naval and military forces in any possible controversy as to boundaries which in no way interest this country. Many people outside of America, many keen students of the League and its strongest supporters, consider this article its weakest point. But since the League is largely dependent on the support of the smaller European states for its virility, and since to them Article X is the heart of the organization, it seems highly improbable that it will ever be deleted. If Senator Lodge's suggestion had been accepted the United States would now be a member of the League, with only a reservation as to that particular article.

Many Americans are foolishly worried over the idea of consultation between nations when there is a threat of war ; or rather, they appear to be worried over an obligation to do what is normally done without any obligation. Equally futile seems the fear that there might be a British bloc against the United States, the self-governing Dominions being independent members of the League. The record of other conferences, such, for example, as the radio conference, proves that the separate parts of the British Empire vote independently, as often with the United States and against Great Britain as the other way around. And furthermore, the man who conjures up the specter of war between the United States and the British Empire can have little if any trust in the friendly character of any international relations.

On the other hand, the obligations arising through Articles 15, 16 and 17 are really serious, because they envisage a resort to war to prevent war. No thinking man could see his government institute light-heartedly economic sanctions against another nation, since sanctions must almost inevitably lead to war. Still less would any American light-heartedly agree that on the decision of other nations as to the rights and wrongs of a dispute American military forces might be used overseas. It may well be that a treaty, ratified by the President after he has received the advice and consent of the Senate, overrides the law of the land as enacted by Congress. It is absolutely certain, however, that it cannot override the Constitution of the United States, and many of the keenest students of the Constitution believe that certain articles of the League covenant, which of course would have the force of a treaty if adhered to by the United States, are in direct contradiction to this fundamental law.

U.S. Relations with League

Relations between the American government and the League of Nations have grown increasingly friendly during the last three administrations.

It was during the Coolidge administration that close co-operation with the League began, that the endless disarmament discussions got under way, that Kellogg put through his anti-war pact which, independent of the League, expressed unequivocally the same idea of world peace which many Americans hold as the one reason for joining the League.

With the inauguration of Hoover the influence of the President on foreign relations became far stronger. Hoover understood international problems and assumed his constitutional rights of direction. There was no ambiguity in his attitude toward the League. He recognized its international value, was entirely willing to permit American representation on League conferences when there was reason for American participation, was determined that there should be no involvement in political questions. During the long drawn out discussions of the Manchurian question he was adamant in refusing to let his country become involved in any kind of sanctions because he clearly saw the consequences to the United States, took a long view of the matter and realized that a great war in which America must almost certainly be involved was an utterly foolish method of stopping a small war.

His influence was both a restraint on the League, pushed forward toward drastic action by the small nations which had no responsibility and nothing to lose, and an impetus to wiser, because less dangerous policies, as illustrated in the refusal of recognize fruits of aggression. The United States never co-operated more usefully with the League than during Hoover Administration; never made more clear that American policy must be fully independent.

The relations between the League and the United States have developed normally under the guidance of a succession of men of vision. Hughes, Kellogg and Stimson were all thoroughly friendly, but without truckling to such League ideas as were un-American. The situation to-day is well balanced, works without friction. The United States loses, through not being a member of the League, only the regular contact of its highest officials with those of other nations which comes through the meetings of the Council ; but, on the other hand, even membership would not bring this without serious detriment. The British Prime Minister can go to Geneva in a day. It takes a week from Washington; and the Secretary of State should be at home, at the seat of the government. The League, politically, is primarily valuable for Europe, and the United States is not a European nation.

What attitude the Roosevelt Administration will take toward the League no man knows. We must hope that it will continue along the lines already developed, not as Republican but as American policy. The League can be useful to us as we can be useful to the League, but the relations should remain those of friends. A formal partnership might well disrupt the friendship and destroy the value of co-operation.

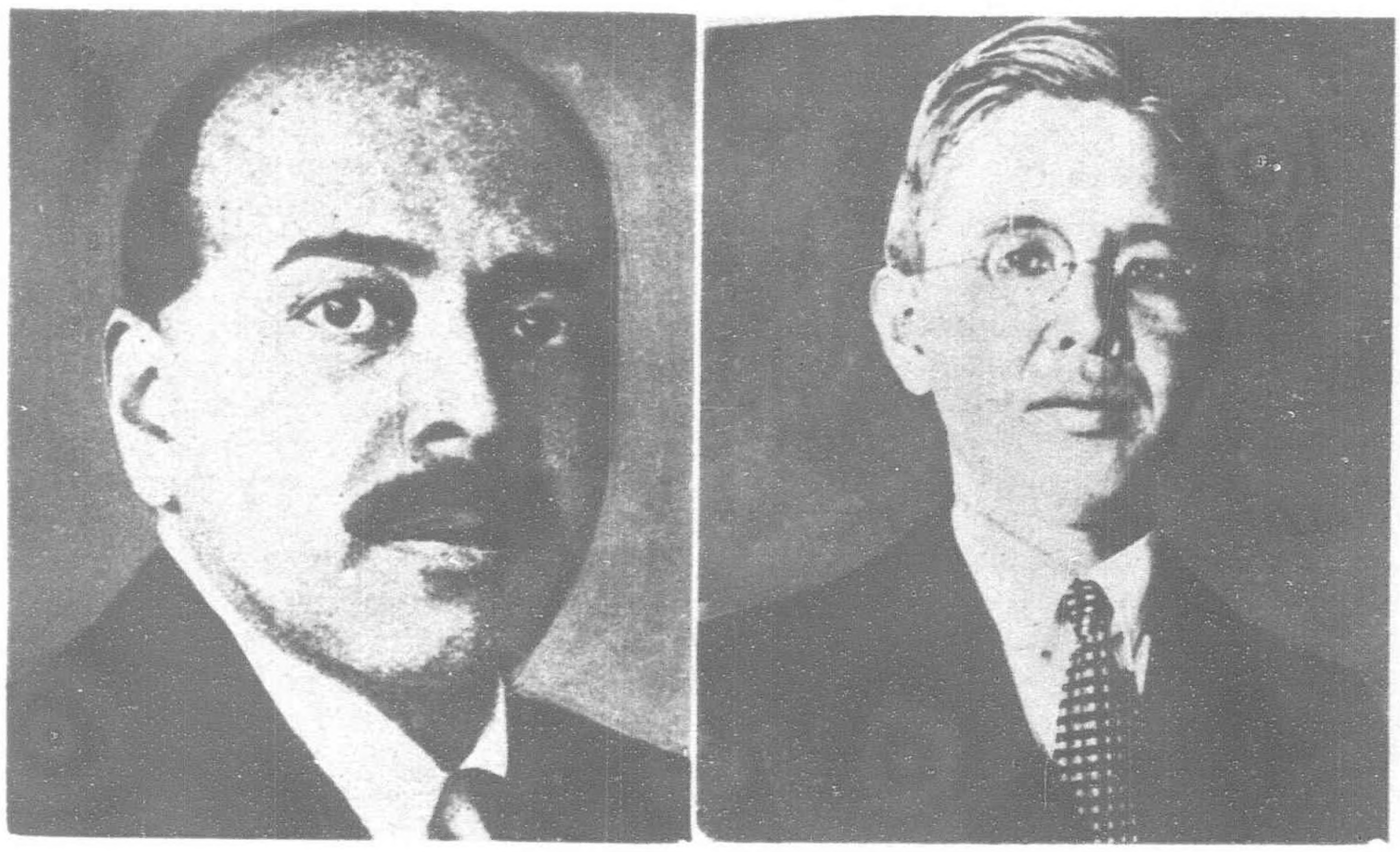
New Delhi Conference Ends

By EISABURO KUSANO

THE Indo-Japanese trade negotiations, which opened at Simla on September 25, 1933, and which were later removed to New Delhi, came to a virtual conclusion on January 5, 1934, when an agreement of views was reached between the Indian and the Japanese delegations on all the major questions at issue. As the result, previous even to the provisional signing of the new convention, the Government of India reduced the customs duties on the import into India of Japanese cotton piece-goods on January 8, 1934. Simultaneously, the Japanese cotton spinners, raw cotton importers, and piece-goods exporters withdrew their joint resolution of suspension of the purchase of the Indian raw cotton, and the control over the Japanese cotton piece-goods export to India has subsequently started.

Japan's public opinion is divided as to the success or otherwise of the Indo-Japanese trade negotiations. It is a fact, however, that neither cotton circles nor the sundry goods exporters at home find the outcome satisfactory whereas the New Delhi agreement is generally approved in the Indian and British circles.

Whatever the public reaction at home and abroad may happen to be, the text of the new Indo-Japanese convention of commerce is being drafted at present along the line of agreement already reached. It is to be signed provisionally in New Delhi by Sir Joseph Bhore, commerce member of the Viceroy's Executive Council and the Indian Chief Delegate, and also by Minister Setsuzo Sawada, head of the Japanese Government delegation. The text will then be mailed to London where it will be formally signed by Sir John Simon, British Foreign Secretary, and Mr. Tsuneo Matsudaira, Japanese Ambassador. Then the convention, for three years and a quarter, is to govern the trade relations between British India and Japan.



HEADS OF THE DELEGATIONS

At Left: Sir Joseph Bhore, commerce member of the Viceroy's Executive Council, and Chief Indian Delegate. Right: Minister Setsugo Sawada, head of the Japanese Government's delegation

History of Controversy

Beginning at the beginning, there are many causes, both remote and direct, which have brought forth the present Indo-Japanese trade negotiations.

It is recalled that the Government of India raised the customs duties on the import into that country of the Japanese cotton piece-goods on four occasions from 1930 up to August, 1932. In April, 1934, the Government of India, without any preliminary negotiations, sent to Tokyo a notice declaring that the then existing Indo-Japanese convention of commerce would be abrogated after a grace of six months. Two months later, or in June, 1933, the customs duties on the Japanese cotton piece-goods were again raised to the prohibitive level of 75 per cent *ad valorem*

The Japanese spinning mills, consequently, acting in concert with the raw cotton importers and cotton piece-goods exporters, passed and carried out a resolution to suspend the purchase the Indian raw cotton, beginning on June 13, 1934, for the purpose of "urging the Government of India to reconsider" what it has done to Japan.

At about the same time, Sir Joseph Bhore informed Mr. Tetsuichiro Miyake, Japanese Consul-General at Calcutta, that the Government of India was prepared to open negotiations with the Japanese Government to find a way out of the then strained relations between the two countries.

The Japanese Government was glad to accept the invitation. The convocation of the subsequent Indo-Japanese trade negotiations, however, was delayed on account of various preliminary preparations, including :

(1) The negotiations on the interim measures to govern the diplomatic relations between British India and Japan following the expiration on October 10, 1933, of the then existing trade convention. (2) the decision of the delegates' status, and (3) the provisional negotiations with the British Government in London as to whether it would recognize the agreement in case such is reached between the Governments of India and Japan.

It was toward the end of August, 1933, that the Japanese delegation consisting of four members, headed by Minister Setsuzo Sawada, was appointed. At about the same time, arrangements were made that separate negotiations should be held among the trade representatives of Britain, India, and Japan side by side with the official conference between the Governments of India and Japan, and subsequently, the Japanese non-official delegation, headed by Mr. Keizo Kurata, was appointed. The two delegations left Japan together for India toward the end of August, 1933.

The first plenary session of the official conference was called to order at the Legislative Assembly Hall, Simla, on September 25, 1933. During the three months and a half that followed, 16 plenary sessions including that on January 5, 1934, were held in addition to a number of private conversations between Sir Joseph and Minister Sawada. In the meantime, the abrogation of the trade convention was postponed by one month following its expiration on October 10, 1933, after the grace of six months. But, after the extension period expired on November 10, 1933, there existed no treaty relations between British India and Japan. The conference, on the other hand, was making but slow progress. Deadlock came over and again. It appeared at one time as though the parley was doomed.

That an agreement was made at last between the Indian and Japanese delegations after all their efforts at Simla and New Delhi may, after all, deserve congratulations as was stated in the comment of the Japanese official circles.

But what about the outcome ?

Fruits of Conference

According to the official communique dated January 7, 1934, which was issued simultaneously by the Governments of India and Japan, the important problems relative to the commercial relations between India and Japan upon which the agreement of views was reached at the plenary session on January 5, 1934, included :

(1) Most favored nation treatment to be accorded reciprocally to the goods of the two countries.

(2) Negotiations to be held concerning the modification of customs duties that may affect the trade interests of the two countries.

(3) Measures to be taken to correct the effects of the exchange fluctuations.

(4) Duties applicable to Japanese cotton piece-goods imported into India.

(5) The quota to be applicable to such Japanese goods, and

(6) The enforcement of the present agreement.

Of the foregoing six items, further details of articles 4 and 5 will be quoted from the official communique :

" *Article 4.*—Customs duties on Japanese cotton piece-goods imported into India :

" Without prejudice to agreement concerning most favored nation treatment and the measures to correct the effects of exchange fluctuations, the customs duties to be imposed by the Government of India on Japanese cotton piece-goods should not exceed the following rates :

" Duty on plain grays, 50 per cent *ad valorem* or 5.25 annas per pound ; duty on others, 50 per cent *ad valorem*.

" It is understood that the Government of India shall not impose on Japanese cotton piece-goods other than plain grays a specific duty exceeding 5.25 annas per pound, subject to agreement concerning most favored nation treatment.

" *Article 5.*—Importation of Japanese cotton piece-goods into India.

" (*a*) The calculation of the quota of Japanese cotton piece-goods to be exported to India in period of one year beginning April 1 (called piece-goods year) shall be limited within a quota which shall be fixed in accordance with the quantity of Indian raw cotton exported to Japan in the period of one year beginning January 1 (called the cotton year) of the same year.

" (*b*) Basic quota and modification of basic quota :

" (1) The basic quota of Japanese cotton piece-goods to be exported to India in a piece-goods year shall be 325,000,000 yards and it shall be linked with 1,000,000 bales of Indian raw cotton exported to Japan in the corresponding cotton year.

" (2) In case the export of Indian raw cotton to Japan in any cotton year should fall below 1,000,000 bales, the quota of the Japanese cotton piece-goods for the corresponding piece-goods year shall be determined by reducing the above basic quota at the rate of 2,000,000 yards for every 10,000 bales of deficit.

" (3) In case, however, such export in any cotton year should exceed 1,000,000 bales, the quota of Japanese cotton piece-goods for the corresponding piece-goods year shall be determined by increasing the above basic quota at the rate of 1,000,000 yards for every additional 10,000 bales, provided that the quota in no case exceeds 400,000,000 yards.

" (4) In case the export of Indian raw cotton to Japan in any cotton year should exceed 1,500,000 bales, the quantity thus exported in excess of 1,500,000 bales shall be, for the purpose of determining the relevant quota of Japanese cotton piece-goods, added to the quantity of raw cotton exported to Japan in the follow-in cotton year.

" (5) In respect to both cotton piece-goods and raw cotton re-exported, the quantity shall be deducted from the imported quantity.

" (*c*) Two half-yearly installments of quota :

" (1) A piece-goods year shall be divided into two half-yearly periods, the first half-yearly period running from April 1 to September 30 and the second half-yearly period, from October 1 to March 31 of the following year.

" (2) The quota for the first half-yearly period shall be 200,000,000 yards.

" (3) The quota for the second half-yearly period shall be provisionally fixed at a quantity which will be derived by deducting 200,000,000 yards from the yearly quota calculated on the basis of the estimated export of Indian raw cotton to Japan in the corresponding cotton year. The adjustment of the export of the Japanese cotton piece-goods to India shall be made by the end of the said period on the basis of the exact quantity of Indian raw cotton exported to Japan in the corresponding cotton year, subject to the rules of allowances between periods.

" (4) A transfer from the quota of the first half-yearly period to the quota of the second half-yearly period shall be permitted up to a maximum of 20,000,000 yards. From the second half-yearly period to the first half-yearly period of the succeeding piece-goods year and *vise versa*, a transfer up to a maximum of 20,000,000 yards shall be permitted.

" (*d*) Classification of quota into categories :

" The quota of cotton piece-goods shall be classified into the following categories in conformity with the following percentage :

Plain grays	45 per cent
Bordered grays	13 " "
Bleached	8 " "
Colored and others	34 " "

" The percentage allotted to each of the above categories may be modified subject to the following conditions :

" (1) An increase in the category either of bordered grays or bleached shall not exceed 20 per cent of the quantity allotted to that category and the increase in any other category shall not exceed 10 per cent of the quantity allotted to that category.

" (2) The quantity transferable from the category of either bordered grays or bleached shall not exceed 20 per cent of the quantity allotted to that category and the quantity transferable from any other category shall not exceed 10 per cent of the quantity allotted to that category, and

" (3) The total quota of cotton piece-goods for any piece-goods year shall not be increased by the above modification of the quantity allotted to each category.

" (*e*) The quota for the period between the enforcement of the arrangement and the commencement of the first piece-goods year :

" (1) The quota of cotton piece-goods for the period between the date on which the present Indian customs duty on cotton piece-goods will be reduced to 50 per cent, and April 1 on which the first piece-goods year begins, shall be the proportionate fraction of the quantity that would have been allotted to the whole piece-goods year from April 1, 1933, to March 31, 1934, on the basis of the quantity of the Indian raw cotton imported into Japan in the cotton year of 1933 (from January 1 to December 31).

" (2) The quota for this period and the first half-yearly installment of the first piece-goods year quota should be consolidated into one for the period of approximately nine months, closing at the end of September, 1934."

It is expected that the British Government will recognize the New Delhi convention without further revision in view of the fact that the nature thereof had previously been shown unofficially by the Government of India to the British Government before the final agreement was reached.

Japanese Reaction

(*a*) Views supporting the agreement :

The *Economist*, a bi-monthly published by the *Osaka Mainichi*, in its editorial of the January 15 number, says that Japan should put up with the New Delhi agreement in consideration of the outstanding world economic trend. In part, it says :

" That the cotton piece-goods export maximum quota is fixed at 400,000,000 square yards, in spite of the fact that the 1932 total export amounted to 640,000,000 yards, will prove a blow to companies which produce mainly bleached and other worked goods. And one must also be prepared to see further declines in the actual export as compared with the nominal volume that Japan may export because the maximum quota is granted on condition that Japan buys 1,500,000 bales of Indian raw cotton.

" On the other hand, that the agreement was brought forth at this point could not necessarily be called a failure if one takes into consideration the sharp falls in the export in and after June, 1933, when the customs duties were increased to 75 per cent. The export in October, 1933, for instance, amounted to a little more than 17,000,000 yards and that was less than one-third of what was used to be exported previous to the tariff increase. Judging by this result, one may well infer the dismal state of affairs that might come in case the treaty relations between the two countries are abrogated altogether.

" On the part of Britain and India, in the meantime, by permitting Japan to export a certain fixed amount of cotton piece-goods, they could prevent an outburst of anti-British sentiment in this country.

"That India and Japan compromised is worthy of congratulations for the two countries concerned."

Japanese Opinion

Mr. Takenosuke Ito, Managing Director of the Ito-Chu Company, one of the largest cotton piece-goods exporters in Osaka, declares that the agreement itself is far from satisfactory, but he finds that there are also favorable points therein.

He is happy to think that the Indo-Japanese trade negotiations have come to an amicable conclusion in the spirit of mutual concession because it promises a smooth progress of similar negotiations which are to be held in the immediate future with Britian, the Netherlands, Egypt, and so on.

He is of the opinion that the fact that negotiations did not break down is no doubt a favorable factor for Japan's cotton industry because the long pending anxiety has been removed. He is optimistic that Japan will be able to find sufficient market in Latin America and elsewhere for the portion of product forced out of British India by the new agreement. He recalls that Japan managed to export a large volume of cotton piece-goods during 1933 in spite of the trouble with India, and he points out that but for the present settlement, the prospects of the cotton industry in Japan for 1934 might have been decidedly pessimistic. He adds that the reduction of the customs duties by virtue of the agreement means better business and that the renewal of purchase of the Indian raw cotton means the further reduction of the cost.

"Admitting that the new agreement is not at all satisfactory, it has favorable aspects as well; for one thing, Japan may export 400,000,000 yards if only we work harder for it, although it is no doubt a hard job," said Mr. Takenosuke Ito.

Another representative optimistic view that prevails in Japan is based on the fact that the maximum quota of 400,000,000 square yards does not include approximately 100,000,000 yards which are re-exported from India to other countries and that from 60,-000,000 to 70,000,000 yards which are imported into India through Kachhi is not included in the maximum quota either. It is recalled that the 1932 total of 640,000,000 yards included the volume re-exported from India and that imported into India via Kachhi. It is pointed out, therefore, that if Japan managed to export the maximum quota of 400,000,000 yards under the new regime, and if about the same volume as in 1932 was re-exported from India and was imported into that country via Kachhi, the actual decrease in and after 1934 will be only a little less than 100,000,000 yards after all.

As regards the import into India via Kachhi: at present, the import duty of 8 per cent *ad valorem* is levied on the Japanese cotton piece-goods entering Baluchistan province, but nothing definite is at present known whether it is duty free from that province to the rest of British India. The Japan Cotton Spinners' Association, Osaka, does not think it possible to export a great deal of piece-goods to India via Kachhi under such favorable conditions.

Views Opposing Agreement

The foregoing are the representative opinion that supports the New Delhi agreement. But vigorous opposition is also voiced, and Mr. Shingo Tsuda, President of the Kanegafuchi Cotton Spinning Company, leads the Opposition.

Mr. Tsuda estimates that the actual volume of cotton piece-goods Japan may export to India under the new regime will fall to about 200,000,000 yards because of "various treacherous restrictions" stipulated in the agreement.

He says that the fundamental cause of Japan's failure in the present negotiations was that the Japanese Government delegates attempted to bring about a "political solution" of the controversy without fully taking into consideration the technical views of the cotton industrialists at home.

In the opinion of Mr. Tsuda, the New Delhi agreement has been concluded to make Japan to buy Y.170,000,000 of the Indian raw cotton (1,300,000 bales at Y.130 per bale of 300 kin) in order to sell Y.25,000,000 cotton piece-goods (200,000,000 square yards), and moreover, the Japanese Government, in order to carry out this contract faithfully, is about to enforce a strict export control.

Mr. Tsuda's sensational statement that Japan will be unable to sell much more than 200,000,000 square yards under the new regime has naturally attracted much attention. It is especially so as the Japanese cotton industrialists as well as the exporters have been planning to sell more and more on the strength of the "superior quality and lower price" and also because the New Delhi agreement has nipped their ambition in bud.

The biggest question at issue here is whether Japan will be able to export to the extent of the maximum quota of 400,000,000 square yards, the various restrictions notwithstanding. And, indications are that the prospects are far from cheerful.

Export will Fall

To sell 400,000,000 square yards of piece-goods to British India, Japan must buy 1,500,000 bales of the Indian raw cotton. And it is doubtful whether Japan will need so much Indian cotton.

During the past 10 years, Japan has annually imported 1,600,-000 bales of the Indian raw cotton on the average. But the volume has been falling in recent years, and in 1932, it was only about 800,000 bales. This marked decline in the consumption of the Indian raw cotton in Japan has resulted from the substantial change in the production. The Japanese mills in recent years show a conspicuous tendency to produce higher grade products and the output of lower counts of yarn is steadily falling. Furthermore, the technical improvement has reduced the per unit requirement of raw cotton for the yarn production. The volume of the Indian raw cotton required in Japan has thus been on the steady decline. It is estimated that the maximum volume of the Indian raw cotton that Japan may ordinarily consume will be 1,300,000 bales.

It appears to be well nigh impossible for the Japanese spinning mills, under present conditions, to buy 1,500,000 bales of the Indian raw cotton, unless the difference in the market quotation between the Indian and the U.S. cotton becomes sufficiently large to induce the heavy import from India.

In view of the fact that the quota granted to Japan decreases proportionately on a sliding schedule when the Japanese purchase of the Indian raw cotton falls, the possibility of Japan's exporting 400,000,000 square yards becomes remote. If Japan's import of Indian raw cotton falls to 1,300,000 bales, the maximum quota for the cotton piece-goods will subsequently decline to 355,000,000 square yards by virtue of the present convention.

There is another difficulty and it is the customs duties. According to the agreement reached at New Delhi, the duty applicable to plain grays is either 50 per cent *ad valorem* or 5.25 annas per pound. This specific duty, when converted into that of *ad valorem* on the basis of the prevailing market quotation, comes up to from 60 to 70 per cent. If such a specific duty is levied, it is feared that the Japanese plain grays will be shut out of the Indian market, with a limited exception of high grade of staff, because the highest tariff walls that these Nippon goods may hurdle is said to be from 50 to 55 per cent *ad valorem*.

The categorical classification is another restriction that is likely to reduce substantially Japanese exports to India. The 1932 export of bleached goods into India amounted to 21 per cent of the aggregate total volume. In the new convention, however, the ratio has been cut down to 8 per cent. Even when the 20 per cent allowance is added, the total increases only to 9.6 per cent. And the prospects of trade in bleached goods have been most promising.

In view of the fact that the duties on plain grays are prohibitively high and that the categorical quota on the bleached goods is far below the quantity that Japan may actually export, it is predicted that the volume of cotton piece-goods that may actually enter British India will be about 30 per cent less than the general quota granted Japan.

If Japan does not need any more than 1,300,000 bales of the Indian raw cotton, the total quota for piece-goods falls to 355,000,000 square yards. And if the actual export further declines by 30 per cent from this quota on account of various restrictions, the total volume of exports will further decrease to approximately 250,000,000 square yards. This total is not much more than Mr. Tsuda's calculation.

Even supposing that Japan imported 1,500,000 bales of the Indian raw cotton, and exported 400,000,000 square yards of cotton piece-goods, this barter trade is not favorable for Japan when the raw cotton and piece-goods are converted into terms of yen and sen. For the price of 1,500,000 bales of the Indian raw cotton reaches Y.180,000,000 according to a recent quotation,

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The Chinese Mechanic: Efforts to Provide a Modern Training

By Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E.

THE astonishing success of the Hongkong Junior Technical School is sufficient proof of the desire of the working class of China to obtain a training for their sons in craftsmanship. This year (1934)—one year after the school was inaugurated—there were about 500 applicants for entry to the school. It is, unfortunately, impossible at present to accommodate anything like that number ; it is as imperative, as it is certain, that extensions of the existing accommodation must be made in the near future. Even if that is done it is quite obvious that there will be, each year, many disappointed candidates for admission to the school.

It is interesting, and even amusing, to mention that, when the project of a junior technical school was first suggested, many people in Hongkong doubted whether it would attract students. The writer stated publicly that it must do so, because Chinese artisans had often requested better training for their sons than was then available.

Every praise is due to the wisdom of Sir William Peel, the present Governor of the Colony, in giving his keen support to the scheme. But his predecessors might have helped in the work years ago.

Clerks and Artisans

It takes a long time to persuade people to accept new ideas. The great difficulty in Hongkong, in that connection, were successive Directors of Education, all keen only on Chinese classics.

Twenty years ago the writer advanced the suggestion that the most urgent need in China was technical education for the artisan class. There were, at that time, facilities for training Chinese clerks, who learnt the English language at school and whose sole ambition was to work in an office. But trained artisans were needed then (and still are needed); trained workmen capable of looking after modern machinery. Concentration of education for office jobs and an entirely theoretical curriculum has resulted in flooding the market with a large number of clerks and others unable to work with their hands.

And in passing, it may be said that the same vicious system has been the curse of University training, not only in China, but in India. Thousands of young men have had no other outlet for their energies but office or official positions. And as the supply has greatly exceeded the demand they have become discontented and often have degenerated into political agitators.

Anxious to Learn

It is impossible to praise too highly the industry of the average Chinese artisan. But, without proper training, he is not efficient in the maintenance of modern machinery. Yet, if he is properly trained, he is capable of doing excellent work in the maintenance and repair of machinery.

" A little knowledge is a dangerous thing." My own experience with excellent but untrained Cantonese mechanics has been as follows. They were eager to find out everything about engines or other equipment about which they knew little. But they have often done considerable harm because they had not been properly trained to do the jobs which they tackled on their own initiative.

Their industry and desire to know all about such machinery has been often, in my own experience, the cause of much trouble. They will make adjustments which do much more harm than good. It is difficult to condemn them when they are obviously so anxious to do all that they can to improve the running of plant. But it is most exasperating to find that a big repair has been caused through interference with a mechanism which could have been easily adjusted if only the workman had understood what was happening or if he had drawn the attention of the supervising engineer to the defect and had carried out detailed instructions from one properly trained.

Since the most urgent need in China to-day is the development of the natural resources of the country it follows that it is essential to have an almost indefinite number of properly trained artisans. This is the age of mass production, and mass production of Chinese artisans is the first preliminary to the efficient development of China.

There is far too great a tendency in the Far East to concentrate attention on politics. What is needed is concentration of the industrial development of China's natural wealth.

The politicians and officials in China simply bleed the people. They tax and tax and rob under almost any excuse. They seem to create nothing but confusion and poverty. But those who open up mines, utilize water power, and carry out irrigation schemes, introduce mechanical methods of saving time and labor by putting power behind the worker and multiply wages—those are the people who enrich the country and benefit the populace by raising the standard of living.

Practical Men Needed

If you discuss the Chinese engineering graduate of a University with experienced European engineers in China they always make the same complaint. They say that these so-called engineers are full of book learning which they are entirely unable to apply to practical engineering work.

It is for that reason that we, in Hongkong, have during the last twenty years adjusted our scheme of engineering so that all of our graduates shall have had a thorough training in workshop practice. And we strongly advise all mechanical and electrical engineering graduates to obtain further practical experience abroad in some large engineering works. The need in China, to-day, is not expert designers or mathematicians. Expert advice can be obtained from experienced European engineers. What is needed is a large number of practical men who can make the wheels go round. These professional (but practical) Chinese engineers must have a much greater number of well trained workmen to carry out their instructions. Therefore there should be many schools for training artisans.

That has been the considered opinion of European engineers in China for many years. It is now being realized by other Europeans interested in industry in this part of the world. But it seems to be a fact ignored by the Chinese Government. It was overlooked, for nearly twenty years, by the education authorities in Hongkong.

Looking Backwards

As some example of the type of mind responsible for formulating a policy of education in Hongkong, in my own experience, from about 1912 until recent years, the following almost unbelievable episode is related. The Director of Education solemnly assured the Senate of the University that Greek should be taught in this center of instruction for Chinese students. Having persuaded the authorities to insist that all Chinese students entering the University (including the engineers) should have a thorough knowledge of the Chinese classics, he suggested lectures to instruct Chinese undergraduates in ancient Greek.

Fortunately the present Director of Education has a much more balanced outlook concerning what sort of training is needed for young Chinese to-day. He is to be sincerely congratulated on his keen support of the idea of the technical school for artisans.

During the recent visit in Shanghai this problem of training artisans in China was discussed at great length with Mr. Frank Gill, O.B.E., Past President of the Institution of Electrical Engineers, Mr. A. J. Percival, Dr. Herbert Chatley, and other engineers. It was also talked over with a number of Hongkong University Chinese engineering graduates in Shanghai, Nanking and Hankow. They all agreed that there should be initiated a strenuous campaign in favor of a modern training for the Chinese artisan. Those so trained would quickly obtain higher wages as foremen and charge hands. They would assist so much to develop industry that the demand for their services must, for many years, greatly exceed supply.

It was encouraging to discuss this problem with those engineers in Central China. They were all very enthusiastic for any scheme of training Chinese artisans. It is worth noting that in an address which was given before the China Center of the Institution of

Electrical Engineers at the Annual Dinner of the Institution on November 23, in Shanghai, Mr. Per ival pointed out that a serious but passing handicap from which China is suffering is the lack of a sufficient supply of experienced practical engineers.

"I have already mentioned" he said "the Lester School and Technical Institute and we welcome the decision of the Trustees to brook no further delay as we are in no doubt whatever as to the urgent need of practical technical instruction to men of the foremen type for whom, I understand, the Technical Institute is primarily intended.

"A competent Chinese factory inspectorate with the necessary experience and technique has yet to be created and the Lester Institute will, I feel sure, prove extremely valuable in this respect in years to come."

It is encouraging to read that Shanghai engineers have spoken so bluntly about this problem. There has been far too much neglect of this grave matter. It is in the interest of everyone, Chinese and Europeans alike, that the efficiency of production in China should be increased. It is the most fruitful and useful missionary work that any one can undertake for it is the only method of fighting the twin evils of poverty and corruption.

In this matter Hongkong has set a good example. Not only in the development of the engineering faculty of its University, but in the idea of a trade school. And also mention must be made of the industrial school which has grown up under the auspices of the Silesian Fathers; a large building, to accommodate hundreds of boys, who will be taught trades, is now being erected by public subscription.

Youth Must Be Equipped

In to-day's issue of the *South China Morning Post* the following headlines are displayed across two columns in a most prominent position. They read as follows:—"Technical Education. Governor Foresees Developments in Present School System. Youth Must Be Equipped."

Sir William Peel was distributing prizes at one of the oldest schools in Hongkong, viz. the Diocesan Boys' School. He said "I hope, however, that at no distant date it will be possible to establish workshops and give some technical training in the School, for I think that this is one of the most important branches of education. It is impossible to get away from the fact that in these days, when the struggle for livelihood has grown more severe, education must of necessity be more utilitarian than in the past. Old traditions have to be modified: culture must certainly not be neglected, in fact it must be taken not to cram Youth with ill-digested and useless information under the guise of culture, which bears little resemblance to the real thing. It is possible that it will become increasingly difficult to do more in this direction than start the individual on right culture lines and leave him to develop along those lines."

Sir William also praised the practical work done by the boy scout troop. That movement in China is enthusiastically supported by engineers, for it does teach a boy to use his hands as well as his head. Sir William said "I am glad to hear that the Scout Troop has now grown to its full size. This movement is a most excellent one and I understand that in connection with it instruction is given to the boys in pioneering work, such as building towers, bridges, etc."

Work Will Win

If industry is defined as habitual diligence in any employment, then it seems to me that, as a race, the Chinese are the most diligent on the face of the earth.

It is not often that the impressions of the casual traveller and old residents in China are the same. But there can be no doubt at all that any fair-minded European, whether he be casual traveller, or a resident in China of long experience, will admit that, as a race, the Chinese are diligent.

There is little idleness in China. It has been cynically said that the only people in China who are doing anything to-day are those who are doing harm. But, although there is just sufficient hint of truth in that statement to arrest our attention, yet, on reflection, we realize that the root causes of the evil are the poverty of the people and the corruption that is rampant in high places.

There is only one cure for those evils. It is in the development of the natural resources of the country. That can only be done by the Chinese themselves. Therefore every effort should be made to increase facilities for all types of technical education. But beyond all other grades what is urgently required is the mass production of well trained artisans.

China's Population Problem*

THE matter of population is one of the most serious which China has to face. There is little doubt that much of China is seriously over-populated, that in North China, and much of East, Central, and even South China, there is not enough land to go around. The population, with technical methods inferior to those of the West, is practically as great as that of Europe, and growing much more rapidly. And this growth, with the already limited resources of the country, means and must mean ever-increasing poverty, ever more frequent and widespread famines, with the steady lowering of the stamina of the Chinese people.

In this connection, it is most unfortunate that Dr. Sun's earlier statements, before he was influenced by Rockhill's sophistries, have been given so little attention. These earlier statements should be the guiding influence in every discussion of population in China, in every school-book reference to population, in every Government approach to the problem. Nothing is clearer to-day than the truth of Dr. Sun's own conclusions, on the basis of his own and other intelligent observations, when in 1894 he wrote in his Open Letter to Li Hung-chang:

> "At present China is already suffering from over-population which will bring impending danger in its wake. She is confronted with a great many hidden uprisings and frequent famines. It is extremely difficult for the populous masses to make a living even during good years, and in time of great drought and famine many people will starve to death. Our food problem is already very acute. The situation will be much worse as time goes on. If we take no timely means of remedy it will surely worry us."

These words, written almost forty years ago, were not only sound and wise, but prophetic. There can be no doubt that since then the situation has appreciably worsened. Statistics are as yet far from exact for China as a whole, but the census returns for various provinces, and the careful surveys made in many localities in many parts of the country, leave no doubt that China's population is already much higher than is compatible with the prosperity of a country mainly agricultural, and furthermore that it is steadily on the increase. And as the population grows, famine and suffering grow, the plots of land become ever smaller, the poorer families cannot feed their children even in "good" times.

The 1912 Census of China, taken under the Yuan Shih-kai régime, was the most complete so far taken of the Chinese people, having regard to the great variety of details given. Three provinces, indeed, were lacking (Kwangtung, Anhwei, and Kwangsi), but for the other provinces figures were given which correspond excellently with modern census results. The total indicated (adding figures for the three omitted provinces) was some 430 millions, more than a hundred million above the Manchu (1910) figures. During the following years most provinces published revised data from time to time, and at least nine provinces have continuous figures for five years. A few years later the China Continuation Committee (C.C.C.), a foreign mission body, in co-operation with Chinese officials and the Chinese Post Office, arrived at a composite figure, for all China Proper, of over 447 millions. The census figures taken in a number of provinces in recent years correspond extremely well with those of the 1912 Census and C.C.C. Survey, though in all cases (excepting only Chekiang) showing further increase.

The 1910 Census of China showed absurdly low figures for practically all the provinces of the south and west (particularly Szechuen, Kiangsu, and Kwangtung), the object of this Manchu census having been to under-represent the radical provinces in favor

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of the more conservative northern areas in the new parliament which was being planned by the monarchist régime. That this fact was recognized by the Republicans is clear from the fact that these returns were wholly ignored by them in apportioning parliamentary represnetation in 1912. But the indefatigable efforts of reactionary foreign scribes have succeeded in having these deliberately falsified Manchu figures perpetuated, and the 1912 Republican figures ignored.

The figures on population recently published by the Ministry of the Interior, based upon recent censuses in some provinces and older figures in others, show 474 millions, which is if anything an under-estimate. Dr. D. K. Lieu considers the population to be somewhere in the neighborhood of this. The Chinese Post Office estimates it some ten millions higher. H. P. Howard, making a careful composite study utilizing census and other figures, reached a total a little higher than that of the Post Office. In any case, it may be said that the population of China to-day is over 470 millions, and probably nearer to 490 millions, even without counting the several millions in the outer dominions, which would bring the total to something approaching five hundred millions. Even subtracting the four north-eastern provinces (with well over thirty millions), and Tibet and Outer Mongolia, the population still remains in the neighborhood of 450 millions.

These bald figures are of little meaning in themselves to the "man in the street." It is as compared with those of other countries, and contrasted with China's resources and low productive capacity with present methods, that they acquire significance. We may consider, for example, that the population is comparable to that of all Europe, with its high development of intensive farming with scientific methods, but furthermore dependent upon a great export of manufactured goods for less industrialized areas, enabling it to purchase food from these latter parts of the world. Or we may consider that the British Empire, also with some 450 millions (some 320 millions of this in densely populated India), occupies over three times the area of China.

What all this means in actual fact, for the people of China, is that in the villages throughout most of the country there are landless people, for whom there is no land available even at the high rentals which are charged by Chinese landowners, and who are reduced to starvation, beggary, or banditry as a result. In the longest settled part of the country indeed, in the northern provinces which constituted Ancient China, even the landowners who rent land to tenants are becoming fewer and fewer. As the population has increased generation by generation, and the landowners divided their land among their families, the portion for each became less and until they were obliged to drive the tenants off the soil and cultivate the land themselves, so that to-day North China is mainly a land of poverty-stricken "owner" farmers, most of them with so little land that they cannot even raise and feed a family on it. So bitter is the struggle for existence, so close do they live to the margin of mere subsistence, that drought or other misfortune means actual famine for millions. In fact the North has become a chronic "famine area," where relief is urgently needed in one area or another practically every year to save great numbers of the peasantry from actual starvation.

Old-fashioned Chinese scholars, with some of the "new generation," refuse to consider population as a "problem" at all, except to declare that further increase is called for, apparently not knowing that artificial limitation of numbers has been practiced since time immemorial, not only among the Chinese but among other peoples. Exposure of infants has been the most common method of keeping down population, in many parts of the world, and the necessity to-day is the spread of more civilized methods. It is frequently believed that the idea of limitation of offspring has as yet touched but the fringe of the Chinese economic and social order, that the masses do not want contraceptive methods, etc. As a matter of fact, the majority of the Chinese people desperately want such methods, and are compelled to actually practice the crudest methods of limitation of population because of ignorance of better methods. The families which breed recklessly are but a minority of the Chinese people, especially in the North. Careful surveys of many villages show that more than half the families—the poorer families—include not more than three or four persons to a family, meaning perhaps one old parent and possibly one child, but not more. The "big families" with seven, eight or more members are from the well-to-do minority where a single household may own scores of acres of land. Most scholars of course come from these well-to-do families. They know little about the poverty-stricken man with but half an acre to feed himself, perhaps an old parent, and possibly an unfortunate wife.

The real point to-day is not whether the Chinese people shall practice limitation of offspring. The poor who make up the mass of the people are evidently practicing it already. Even if we disregard the evidence of widespread exposure of infants, the sale of abortifacients and use of most brutal and violent methods of abortion, the enormous difference in size between the big Chinese upper-class family and the small worker or peasant family leaves no doubt whatsoever that the poor are perforce practicing limitation of offspring. The main question, to any Chinese with the welfare of his people at heart, is as to how more modern, more scientific, more humane and civilized methods of limitation may be substituted for the old methods.

There is, indeed, a question of developing the knowledge and practice of contraception among the better-off people as well, particularly among the middle-class peasantry, whose fecundity often means (with the subdivision of land) poverty for their children. Prevention is far better than cure, and it is vital that the process of steady decline in living standards should be checked among those still above the poverty line.

It is to be noted that China's population problem has to do both with her internal life and her foreign relations. It is the pressure of population in North China which is sending millions of farmers to seek land and a livelihood in the Manchurian provinces, just as it is pressure of population in the South which is sending millions overseas to seek a livelihood in the Dutch East Indies, Malaysia, and elsewhere. The problem came up at the Banff Conference, where the Japanese have reiterated their plea for relief for their surplus and still expanding population, as if this reckless and rabbit-like breeding justified the seizure of Chinese territory. Thus had the Chinese delegates been of the type who wrote some of the school textbooks, they might have remained silent, and made no reply to this. Being scholars rather than ignoramuses, however, they pointed out that "China's surplus population was four and a half million yearly as compared with Japan's one million, and therefore China's need of an outlet for her excess population exceeded that of Japan." "Manchuria," they declared, "was the logical outlet for China's teeming millions."

It is a fact to be ignored that the foreigners who are most indefatigable in attempting to show China's population as comparatively small, and decreasing, are generally also most distinctly pro-Japanese. The motive of such persons is clear. If China's population is not excessive, and furthermore is declining, she has presumably less claim to her more sparsely settled dominions which the "overcrowded" Japanese covet. The dangerous thing about it is that so many Chinese are being misled to-day by this subtle propaganda of the enemies of China.

New Delhi Conference Ends

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and that of the piece-goods amounting to 400,000,000 square yards is about Y.70,000,000. Where the trade balance is concerned, Japan is to buy Y.110,000,000 more from India than what Japan sells to that country.

The present Indo-Japanese trade negotiations, in addition to problems concerning the cotton industry, deal with those of sundry goods. Japan, as a matter of course, dispatched trade representatives of the sundry goods interests to India, and they have come home pleased with the thought that an amicable agreement was reached on outstanding questions concerning sundry goods. But the Government of India has greatly increased the duties on Japanese sundry goods. This decision has come like a thunderbolt out of clear skies to the Japanese sundry goods exporters as some of their business is utterly killed while that of others is severely affected.

The Japanese cotton people yielded on many points out of respect to the welfare of the sundry goods trade, while the sundry goods exporters allege that the dismal outcome has resulted from the fact that the cotton issues were treated as the main subject of the conference. But what has been decided is decided. India has won.

Two Years of National Reconstruction*

By WANG CHING WEI, President of the Executive Yuan of the Nanking Government

GENERAL CHIANG KAI-SHEK and myself on February 11 issued a joint circular telegram reiterating the importance of suppressing Communist-banditry and the promotion of productive reconstruction as essential conditions for the salvation of the nation and preservation of the race. Under the able direction of General Chiang at Nanchang and supported by the loyalty and bravery of the Bandit-suppression forces, the anti-Communist campaign has made considerable progress during the past year. In addition to the superior military tactics of the Government forces, the construction of a chain of block-houses and the building of highways have contributed much towards the success of the bandit-suppression operations. The net-work of highways constructed by the Government has neutralised the effect of the guerilla tactics pursued by the Communist bandits, and if we continue to deal with them in this manner, I believe success will soon attend the Government's efforts to suppress Communist activities.

The work of productive reconstruction, however, calls for the employment of not only men of talent but of material supplies. Owing to the impoverished state of the country, only a few things have been done in this direction, though many other projects of this nature are demanding the attention of the nation. This naturally causes some people to feel discouraged, and it is even said at times that productive reconstruction is no more than an empty phrase. It must be remembered, however, that the various Government organs are merely supplied with maintenance expenses, and are not given sufficient funds for the active work of national reconstruction. During the Government's campaign against the Communist bandits, even the Government forces are not supplied with "reconstruction funds," and due to the large number of soldiers employed in these operations, maintenance expenses are often insufficient to meet their requirements.

These are undeniable facts, and it is therefore premature to take too optimistic a view regarding the future of the Government's programme for the productive reconstruction of the nation. At the same time, however, the promotion of natural productivity being the only way to develop the strength of the people and consolidate the national vitality, we must do all within our power for the fulfilment of this important mission. Owing to lack of material resources, the work of productive reconstruction should proceed on a modest, if not large, scale; if we cannot undertake any new projects, we should at least complete the old ones; if we cannot make active efforts for the reconstruction of the country, we should at any rate remove all obstacles to such efforts. We should, in short, devote untiring efforts for the accomplishment of this task, since great deeds are often performed by the accumulation of small efforts. It has been well said that rivers are formed by the accumulation of drops of water, and that mountains are formed by the accumulation of grains of sand. We must therefore persist in our efforts, and never allow ourselves to give way to despondency.

National Railway Developments

The Government does not claim to have made any great achievements during the past two years, but we have consistently made it our duty to carry out the programme of national reconstruction so far as possible. This can be proved by a review of the Government's efforts at the development of the national railway system and the general system of communications, from which it will be seen that productive reconstruction has been much more than a phrase, and has been actually carried into effect, and will be steadily pursued. It is, of course, impossible for me to review all our achievements in the field of productive reconstruction in this brief survey, and I shall cite but two examples.

First of all, let us take the development of the national railway system. Railways serve as the life-giving veins of a State, similar to the bloodvessels of a human being. During the past two years, the Government has been devoting its attention to the accomplishment of two tasks, namely, (1) the construction of new railways and (2) rehabilitation of old lines. While it is difficult to recondition all the railways that have fallen into a state of dilapidation as the result of long neglect in years past, this work is an essential condition to the construction of new lines. The Government, therefore, has decided to proceed with these tasks simultaneously. While the completion of the railway net throughout the country on a large scale will of course require a number of years, the Government will not shirk this responsibility on the excuse that material resources are lacking.

Among the more important railways in course of construction during these two years may be mentioned the following: (1) the Canton-Hankow Railway, which has been left uncompleted for the past 23 years but which will be finished within the next three years; (2) the extension of the Lung-Hai Railway to Shensi and Kansu, which will be in operation as far as Sian on or about National Independence Day (October 10) this year; and (3) the Chekiang-Kiangsi-Hunan Railway, on the lower reaches of the Yangtze River. While the Canton-Hankow and the Lung-Hai Railways are lines which have been left half-completed, the Chekiang-Kiangsi-Hunan Railway is an entirely new line. When completed, the Canton-Hankow Railway will become the central trunk line connecting North and South China; the Lung-Hai Railway will facilitate the development of the North-West; the Chekiang-Kiangsi-Hunan Railway will bring about closer economic and cultural relations between the South-Eastern provinces. In addition, harbor-works have been built at Laoyao, on the Lung-Hai line; the North Station at Shanghai, on the Nanking-Shanghai line, has been reconstructed on improved lines; the Pukow railway-ferry service has been inaugurated; and the Hangchow-Kiangshan Railway in Chekiang is in operation. In addition to these achievements, innumerable improvements have been made by provincial and private interests for the development of the railway system, and though these are of less significance than the construction of the three main lines mentioned above, they have an important bearing on the development of the national railway system.

The construction of railways obviously necessitates the expenditure of a substantial amount of money. Realising the economic backwardness of the country, the late Party Leader (Dr. Sun Yat-sen) advocated a policy of inviting foreign capital for investment in Chinese railway enterprises. That policy we adhere to, fully realising that, in order to attract such investment, we must give adequate security, at the same time maintaining the credit of the Railway Administration in regard to existing obligations. The Government therefore is paying close attention to this matter of credit. Under specific conditions, the Government will not only welcome foreign economic co-operation but will exert all the influence within its power to safeguard the interests of its creditors. Although the Government is not in a position to repay at once the defaulted instalments of the railway loans, it is determined to make satisfactory arrangements for their adjustment, subject to proper safeguards for the protection of the mutual interests of both the railways and the creditors. During the past two years, it has devised practicable measures for the amortization and readjustment of some of the domestic and foreign railway loan obligations. These are divided into three categories, namely, (1) railway financing, (2) obligations for railway supplies, and (3) short-term loans. In the first category are included the obligations of the Tientsin-Pukow, Nanking-Shanghai, Shanghai-Hangchow-Ningpo, Taokow-Chinghua, and Kaifeng-Loyang Railways. Measures for repayment have been devised and some have already been carried out. The obligations of the Peiping-Liaoning Railway have been fulfilled according to the terms of the agreement. During these two years the obligations for materials supplied in the past to the railways have been readjusted and definite arrangements for settlement of obligations amounting to $100 millions have been made with the British and American creditors. The short-term loans, forming the third class, are mostly contracted from Chinese banks; measures for their amortization have been devised, and some have been already carried out.

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Adverse Factors to be Faced

It is true that not all the railway obligations of the Government have been so readjusted and amortized, but if we continue to follow the policy now being pursued, the day will come when we shall have amortized all our obligations. Foreign creditors have been criticizing the Government for failure to pay off its obligations on maturity. While this failure is regretted, we wish to call the attention of our creditors to the following two points: In the first place, the failure of the Government to liquidate its obligations has sometimes been due to sudden and unexpected turns in the political situation. Such things happen not only in China, but also in America and Europe, and we cannot blame any one party or circumstance for such failures, since their causes are complicated. For instance, with the outbreak of the World War in 1914, various foreign financial groups failed to fulfil the terms of their loan agreements entered into with the Chinese Government, with the result that construction work on several railways in this country was suspended, and in consequence heavy financial loss was sustained by the Government, since interest on the instalments already advanced had to be paid. While our creditors cannot be wholly blamed for this, it is also true that the blame cannot be laid entirely at the door of the Chinese Government. Again, due to the world-wide economic depression and depreciation of silver, the financial obligations of the Government have been largely increased, while at the same time railway revenues have considerably decreased. Since the economic depression and its various reactions are like a natural catastrophe against which no country can offer effective resistance, it is scarcely fair to put the blame on China alone.

In the second place, it should be understood that the Government has no intention whatsoever of evading repayment of its matured loans, and is anxious to find ways and means of meeting its obligations, but the first essential is a general revival of railway business. With increased revenues available, the interests of creditors will be more fully protected, and it is hoped our foreign creditors will co-operate with the Government to this end. The best proof of the determination of the Government to pay off its foreign railway obligations is afforded by the fact that during the last two years it has discharged a number of such obligations thereby showing not only its desire but its ability to carry out its pledged word. If our foreign creditors realise these facts, and recognise the difficulties with which the Government is faced, their sympathetic co-operation will promote the interests of both parties.

Let us now turn to the efforts of the Government during the past two years for the development of various general communication facilities. The most important achievements have been effected in the following directions, (1) postal service, (2) telegraph service, and (3) shipping. Recently civil aviation has also become an important branch of the Government's work in promoting the development of general communication facilities.

The Postal Service

With reference to improvements in the postal service, I may point out that a mail service has been in operation in China for the past sixty years, and has been generally efficient, a large postal revenue being collected every year. The Government has attempted to further improve and extend the service, but owing to serious floods and Communist disturbances, as well as the North-Eastern crisis, development of the postal service has had a severe setback. A loss of $10,000,000 was sustained, and the internal organisation of the service was seriously dislocated. The Government during the past year has made vigorous efforts to effect a readjustment of the service, with special reference to improvement of the postal remittances and savings service. In the existing circumstances, the Government has been compelled to adopt a strict policy of retrenchment in the postal service, while simultaneously making plans to increase the postal mileage and postal agencies. According to reports submitted by the Directorate-General of Posts at the end of June, 1933, there were 12,000 post-offices and 32,000 postal agencies throughout the country, with a postal mileage of 490,000 kilometres. Plans are being devised for the establishment of more post-offices and an increase of postal mileage by at least 5 per cent as well as an extension of postal service to the border provinces during the current year.

In developing the postal remittances and savings service, the aim of the Government has been to safeguard the interests of depositors. For this purpose, plans have been made to place the Postal Remittances and Savings Bank under the jurisdiction of the Postal Administration, at the same time preserving its accounting integrity. A supervisory system will be created to make public the accounts of the Bank, and severe restrictions will be imposed on investments by the Bank. All these measures will be formally adopted by the Legislative Yuan, but some are already in force, and public confidence in the postal remittance and savings system has been greatly enhanced. Moreover, the Government has ordered the refund of deposits to those who resided in the North-eastern provinces (in spite of the forcible seizure of the postal remittances and savings banks there by the Japanese). This has further increased public confidence in the system. Following the Japanese invasion of Shanghai on January 28, 1932, the business of the Postal Remittances and Savings Bank declined considerably, but it has since returned to normal, and is increasing rapidly, but this turn in the business fortune of the Bank has not been brought about without considerable effort.

Telegraph Administration

The achievements of the Telegraph Administration during the past year have been in two directions, namely, international and inter-provincial service. The former service was formerly operated entirely by cable, but since the inauguration of the great wireless station at Chenju, we have been maintaining communication with the United States, France, Germany, Switzerland, Manila, Java, Saigon, and Hongkong. The agreements with Great Northern, Eastern Extension, and the Commercial Pacific Telegraph Companies, have been revised, thereby effecting the recovery of our cable rights. New wireless circuits to America and Soviet Russia have been inaugurated, and a special radio station for direct service between China and Great Britain has been established to facilitate commercial transactions between the two countries. The station was established in a very short time, and its service has been very satisfactory. Another large wireless station, similar in size to that at Chenju, is being constructed at Loyang (Honan), and will be completed in the near future.

In regard to telegraphic communication within the country, the Government has devoted immense effort to repairing lines damaged during the various civil wars. Up to date a total of 12,000 *li* has been repaired and 5,000 *li* of new routes have been opened including the Hankow-Chengtu line, covering 2,500 *li*. This is an important line connecting Central China with Szechuen and Tibet and will be completed shortly. Out-of-date apparatus used in fifty districts has been replaced by new and modern instruments to facilitate the transmission of messages. Wireless stations were formerly established only in a few of the more important centres, but in order to bring about closer relations between the border territories and China Proper, efforts have been made to extend wireless facilities to such remote provinces as Shensi and Mongolia. A wireless station was established last year at Sian and another at Kalgan (Charhar). The Sian station is intended for the development of the North-western provinces, while the Kalgan station serves to promote closer relations between the Mongolian population and China proper. It was originally planned to establish eight wireless stations each in Sinkiang province and in western Mongolia, but owing to the unsettled situation in those regions the plans of the Government have been impeded. Nevertheless, stations are being established in other border areas, including Charhar, Suiyuan, Kansu, Chinghai (Kokonor), Ninghsia, Szechuen and Hsikang, and will be completed within a year.

With regard to the telephone service, attention has been paid during the past year to the development of the long-distance and city connections. Plans have been devised and carried out of centralized control over the long-distance system, and measures are being devised for converting city telephone services into a State enterprise. A set of regulations has been promulgated governing the operation of long-distance services by various Provincial authorities, which does not, however, conflict with the fundamental plan for unified control over the telephone system by the Central authorities.

During the past year plans were completed for the installation of long-distance telephone services connecting Nanking with Hongkong, Tientsin, and Hankow. Construction work on the

Nanking-Shanghai line, along the Nanking-Shanghai Highway, is nearing completion, while the Nan-Fu (Nanchang-Fuchow) and the Peiping-Charhar lines are already in operation. Plans have been also devised for the operation of telephone services in the provinces of Kiangsu, Chekiang, Anhwei, Honan, Shantung, and Hopei by utilising the telegraph wires and posts already installed in those provinces. Over 300 districts in the above-mentioned provinces are now connected by telephone. It is also planned to establish a telephone network in the province of Kiangsu, the first stage of the programme being already under way. Measures were also adopted last year to improve the telephone service in a number of cities, including Shanghai, Wuchang, Hankow, Tientsin, Tsingtao, Soochow, Chengchow, and Chinkiang. The service in Shanghai is by far the most modern and efficient system in the country. Wireless telephony will be shortly operating in Nanking, Hankow, and Foochow, while an international wireless-telephonic service will be inaugurated in the near future.

Position of Shipping

The situation in the shipping business is a source of national humiliation, both inland and coastal shipping service being still monopolized by foreign interests. The Chinese merely operate two shipyards—the Kiangnan Dock and the Mamoi Dock—and the China Merchants Steam Navigation Company. Though the C.M.S.N. Co., has a history of over 60 years, its business has steadily declined owing to mismanagement. There are very few shipping companies operated by private interests. Construction work requires a substantial sum of money, since every ship represents a value of several million dollars. The Government deemed it expedient to take over the China Merchants' Company and convert it into a State-operated concern. The shares of the Company were bought up by the Government, and a receivership committee organized to arrange for the conversion. Since being taken over by the State, the Company has made considerable progress and improvement, as evidenced by the fact that in the course of the first six months of last year (1933), its total receipts amounted in round figures to $3,660,000—representing an increase of 3 per cent over the corresponding period of the preceding year (1932). Simultaneously, efforts were made to repair old and dilapidated ships, warehouses and wharves, as well as to purchase new vessels, including four ocean liners for the Shanghai-Hongkong-Kwangtung route, and three river steamers for the Shanghai-Hankow-Ichang route. These new ships will be in service by the autumn of this year.

Civil Aviation

Let us now review the achievements of the Government in the field of civil aviation. Two air mail and passenger services are being operated, under the Ministry of Communications, by the China National and Eurasia Aviation Corporations. Whereas, before 1933, the air services of the China National Aviation Corporation only consisted of the Shanghai-Hankow and Shanghai-Peiping routes, the efforts of the Government to develop the service have resulted in an extension to Chengtu, thereby inaugurating a new air route to Szechuen province. Moreover, the former Shanghai-Peiping service, which was later suspended, has been transformed into a coastal air service. An entirely new route—the Shanghai-Canton Airway—has also been inaugurated, and efforts are being made to open a new route from Chengtu to Kueiyang (Kueichow) and Yunnan, a test flight on this route having been already made.

The service operated by the Eurasia Aviation Corporation connects Shanghai with Tacheng (Sinkiang), whence it will connect with Berlin via Soviet Russia. It is to be regretted, however, that the Shanghai-Tihua service, which had been in operation for a few months, has been suspended owing to the unsettled situation in Sinkiang province, the service now only reaching Lanchow, provincial capital of Kansu. Plans are being made for the early resumption of the service.

Besides the above-mentioned air routes, the Corporation has also inaugurated several branch airways, including the Lanchow-Sining (Ninghsia), the Tihua-Ili, and Tihua-Tashkent routes. The Sian-Peiping route is already in operation, while measures are being adopted for the inauguration of a Canton-Hankow-Sian service, tests flights on the Canton-Hankow section having proved successful. Commercial service on this section will be inaugurated as soon as the aerodrome in Canton is completed.

I have thus far merely reviewed some of the outstanding achievements of the Government in developing the postal service, telegraphs, merchant shipping, and civil aviation. The fundamental policies of the Government have been four-fold. Firstly, it has attempted to readjust the organization of these systems, abolishing and amalgamating those organs which are either superfluous or inefficient, in order to increase their efficiency. This is especially true in the case of the telegraph service, in which efforts have been made to amalgamate the telegraph and telephone organs, and the telegraph and wireless organs. Plans have also been made for the amalgamation of post-offices and telegraph-offices in small districts, so as to form a more unified system of communication. Measures in this regard have already been officially announced, and are being enforced.

In the second place, general communication enterprises being of a commercial nature, efforts have been made to introduce a new accounting system into their operation, with the object of making them self-supporting as well as facilitating their eventual expansion. Both Chinese and foreign chartered accountants have been engaged with a view to publishing the accounts of the various organs concerned. This has also been done in the China National Aviation Corporation, the Eurasia Aviation Corporation, the various post-offices, the Postal Remittances and Savings Bank, the China Merchants' Steam Navigation Company, and the Bureau of International Telegraphs, as well as other telegraph and shipping organs.

In the third place, efforts have been made to improve the efficiency of the personnel of the various organs concerned. Thus, the postal Administration has during the past year taken appropriate steps for the rationalization of postal management, while the telegraph organs have also adopted measures for the elimination and dismissal of those employees whose efficiency is not up to standard. Plans have been also devised for the reduction of communication charges, so as to meet the needs of the general public.

In short, it has been the aim and endeavour of the Government during the past year to modernize, commercialize, and convert into proud State enterprises, the Postal, Telegraph, Shipping and Aviation services. For the realization of this task, it has spared, and will continue to spare, no efforts in spite of the various difficulties involved. Such being the work and aspiration of the Central authorities, it will be seen that the Government's advocacy of the promotion of productive reconstruction, is not merely an "empty phrase." On the contrary, it represents the considered and settled policy of the Central authorities, for the realization of which the effort and co-operation of the entire nation will be enlisted.

With regard to our foreign relations, I may mention that the Government has been severely criticized by some people for its so-called "weak-kneed" foreign policy. The Government prefers not to reply to these criticisms for two reasons. If the charge is made in good faith, the Government is not disposed to argue the point. On the other hand, if it is made with malicious intent, then it is not worth a reply. However, the Government is ready to admit that it is weak and powerless. To rectify this weakness, there is only one thing to be done—to develop the strength of the people and consolidate the national vitality, which cannot, however, be achieved except by productive reconstruction. On this depends our ability to resist foreign aggression. Only when we are in a position to fight other people shall we be regarded as fit to be their friends; and unless we are fit to be their friends, we cannot be their enemy. All this, however, depends on one thing, namely, *force*. The nation must abandon all conceited ideas. Unless we do so, we cannot expect international sympathy for our cause. If I were asked what should be our foreign policy under present circumstances, I would reply: Settlement and improvement of the domestic political situation must be the watchword of China's foreign policy; for only when we have put our domestic affairs in order will people be willing to become our friends. To appeal to outsiders for help at this hour merely adds to our national humiliation; while to seek to array them against one another is merely to invite our own destruction. Foreign relations being merely one aspect of our domestic affairs, we are convinced that only by an improvement of the domestic situation can the nation hope to solve its diplomatic difficulties and overcome our national weakness.—*Nanking, February 19th.*

Manchoukuo's Construction Program*

By CHIH PIAO, Second Secretary, Manchoukuo Legation, Tokyo

THE development of Manchoukuo and the improvement of cultural institutions in the country, in accordance with the policies and principles which have been made clearly known to the world through the statements issued by the Government, are now well under way.

The bandits who numbered some 360,000 in 1932, the period of their greatest activity, have been gradually pacified or suppressed, thanks to the combined efforts of the Japanese and Manchoukuo troops. Their numbers were only about 60,000 even during the late summer and early autumn of 1933, a season most favorable to their operations, as the kaoliang plants then attain their greatest height. Thus peace and order have been restored to such an extent that efforts can now be concentrated on economic and social development for the future prosperity of the new nation. On the success of such development will undoubtedly depend the realization of the ideal inspiring the founders of the new State, that of making Manchoukuo a model realm according to the principles of *Wang Tao*, the Kingly Way. For this reason every effort is being made by leading Manchoukuo citizens, official and private, to carry out the new programs with the maximum of rapidity and effectiveness.

The Manchoukuo authorities are determined to remedy the defects of the old economic system which exploited the many in the interest of the privileged few. In its stead will be established

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Scene in West Park at Hsinking, Capital of Manchoukuo

Two views of Central Avenue, one of Hsinking's main thoroughfares

A Bird's Eye View of the City of Hsinking

a new system free from radical theories or fallacies liable to undermine completely the social structure, as is the case with Communism or Socialism, but aiming always at stabilizing the life and promoting the prosperity of the people as a whole. For this purpose the Government exercises control over enterprises connected with transportation, communication, certain sections of the money market, the electric and gold mining industries, and such other industries as have an important bearing on national defence, by means of State operation, semi-official management, or licence or permit systems. The other industries are all open to free operation, and foreign investments in such industries are welcomed, although it may happen that the Government will introduce control in some of these industries, should the need arise, with a view to avoiding unfair concentration of interest or to effect rationalization for the common benefit of the people.

Development of Communications

The development of agriculture, which forms the foundation of Manchoukuo's economy, and other resources : the maintenance of peace and order ; the promotion of commercial prosperity ; and the cultivation of economic relations with foreign countries : all these depend on the adjustment and improvement of communications. It thus constitutes the most important of all the basic tasks in the economic construction of the new nation. Accordingly all important enterprises connected with transportation and communications have been placed under State control in the hope of thereby facilitating their speedy and rational development.

(1) RAILWAYS.—The Government's policy of railway construction aims at developing the national economy, securing the national defence, and maintaining peace and order. In pursuit of these aims the railway program calls for an ultimate extension of the total mileage of 25,000 kilometers, it being planned that during the next ten years 4,000 kilometers of new lines will be constructed to bring up the present total mileage to 10,000 kilometers.

At present the railway network is far from covering the whole country and, what is worse still, various short lines have been operated under separate management causing great inconvenience to the public and, in many cases, unnecessary loss to the operators themselves. It has been thought necessary, therefore, to unify these different railways and promote their economic and technical efficiency through rational management. The South Manchuria Railway Company, with its many years' experience in railway operation in the country, is obviously the best qualified organization to undertake such management. Moreover, such an arrangement will prove convenient to the State of Manchoukuo in settling the enormous debt it owes to the South Manchuria Railway Company in connection with various railways within its territory.

It is in view of these considerations that the Manchoukuo Government concluded a contract with that company to entrust the latter with the

Nipponbashi Street, Hsinking

Anzen-Bashi, Hsinking

The South Manchuria Railway Station at Hsinking

Work of Reconstruction under way at Hsinking, summer of 1933

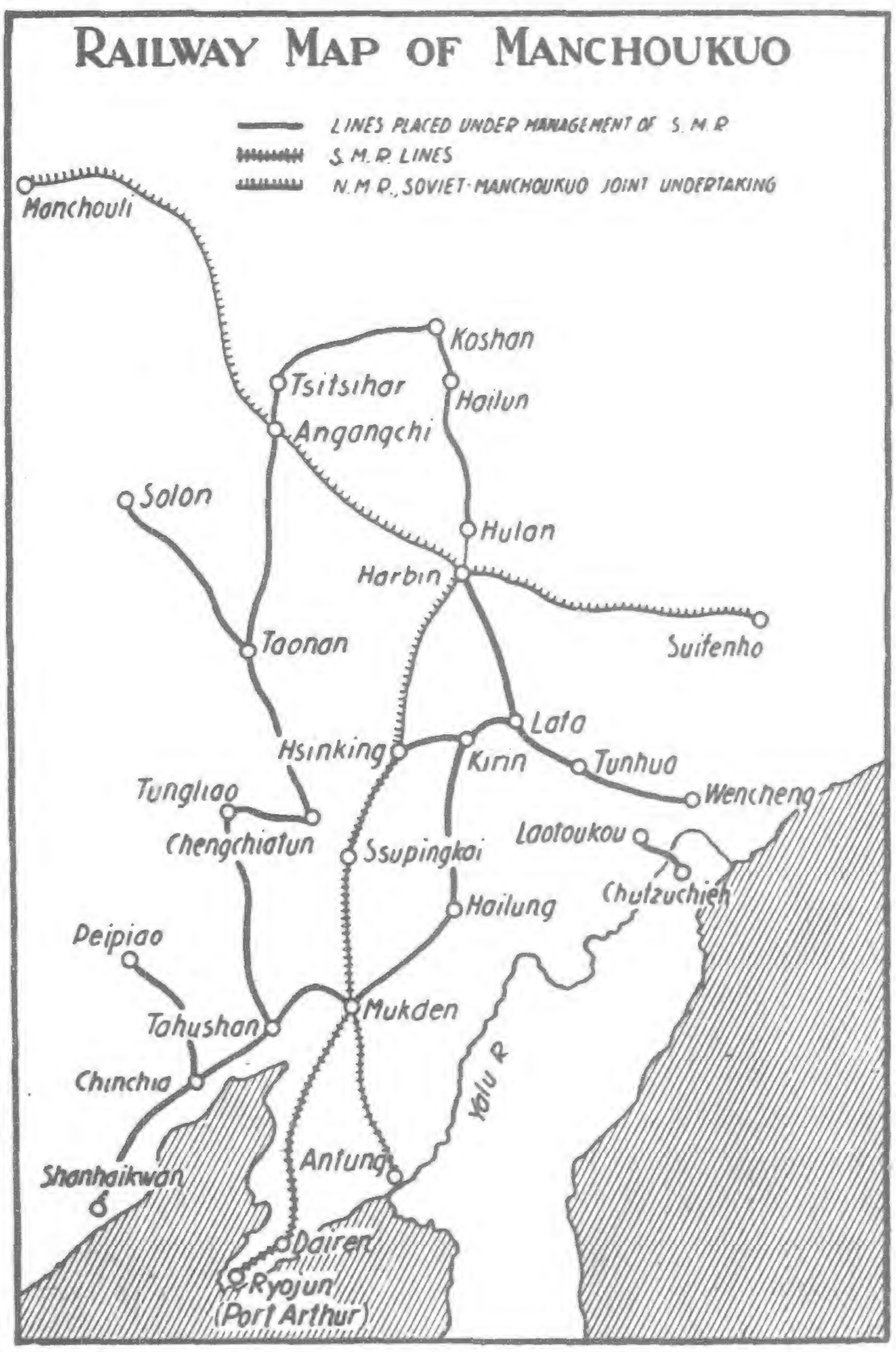
management of the existing railways and the construction of new lines. A general outline of this contract was published by the South Manchuria Railway Company and the representative in Tokyo of the Manchoukuo Government on March 1, 1933. According to this contract the Manchoukuo Government has fixed the total amount of its indebtedness to the South Manchuria Railway Company in connection with the existing lines of the Kirin-Changchun Railway, Kirin-Tunhua Railway, Kirin-Hailung Railway, Ssupingkai-Taonan Railway, Taonan-Angangchi Railway, Tsitsihar-Koshan Railway, Hulan-Hailun Railway (including river transportation on the Sungari River), Mukden-Hailung Railway, and Mukden-Shanhaikwan Railway (inclusive of the Tahushan-Tungliao line and the ports and harbors belonging to the railway), at approximately 130,000,000 gold yen, the security for which is to be the properties of, and revenue derived from, the railways in question, the management of which has been entrusted to the South Manchuria Railway Company.

As regards the railway credits or debts between the Manchoukuo Government and third parties, the South Manchuria Railway Company will undertake to deal with them after consultation with the Manchoukuo Government. Payments in this connection and the refunding of the loan which the Mukden-Shanhaikwan Railway owes to the British and Chinese Corporation will be effected from the railway revenues under the new management. Such property of the Mukden-Shanhaikwan Railway as constitutes security for the British and Chinese Corporation's loan will be excluded from the security for the debts as provided for in this contract pending the liquidation of the said loan.

The Manchoukuo Government has also entrusted the South Manchuria Railway Company with the building of the Tunhua-Tumenkiang Railway, Lafa-Harbin Railway and Taitung-Hailun Railway at an estimated total cost of approximately 100,000,000 gold yen. It is to be noted that the Chinese Eastern Railway, which has been re-named "The North Manchuria Railway" by the Manchoukuo authorities, is not involved in this contract.

The conclusion of this contract has resulted in terminating all unnecessary competition, unwarranted oppression and inconvenience in traffic connection, such as has hitherto been experienced, and the industrial development of Manchoukuo as well as the journeys of ordinary travellers have been considerably facilitated. Further, the construction of the new lines will greatly contribute to the progress of world transportation and communications by making a considerable cut in the distance of travel between the United States and European countries via Japan.

The organization of the North Manchuria Railway, the sale of which is under negotiation at the Manchoukuo-Soviet conference, opened in Tokyo towards the end of June, 1933, through the good offices of the Japanese Government, is based on the Soviet-Chinese and the Mukden-Soviet agreements of 1924. The principal organs of control are the board of directors, the board of auditors and the supervision bureau. The board of directors is the supreme organ of decision, and the Soviet Union and Manchoukuo are each represented on it by five directors appointed by the respective Governments. The director-in-chief or governor is appointed by the Manchoukuo Government and the assistant director in-chief by the Soviet Government. Seven directors form a quorum and decisions are carried with the consent of more than six. The board of auditors, which is exclusively an organ of supervision, has five members, of whom two represent Manchoukuo and three the Soviet Union. The auditor-in-chief is appointed by the



Two other views of Reconstruction Work proceeding at Hsinking

Manchoukuo Government. The supervision bureau is an executive organ for the conduct of the general routine business of the railway and is headed by a Soviet chief and two vice-chiefs citizens of Manchoukuo and the Soviet Union respectively.

(2) HARBORS.—In order to expedite the economic development of the country and effect the economic connection between the producing districts and the outlets to the sea, the Manchoukuo Government has as its policy to utilize its own ports as well as those of neighboring countries to the best advantage, instead of relying on Dairen alone. In line with this policy, improvement is being planned at Yinkow and Antung. Although the completion of the harbor construction at Hulutao will be postponed until such time as the need for such a port becomes more urgent, it is generally expected that the work will be resumed and other harbors built with the gradual economic development of the country. As for maritime transportation, provisions for coastal lines will be improved to meet immediate needs, while efforts will also be made to develop ocean lines. The operation of these ports and harbors has been entrusted to the South Manchuria Railway Company under the recent contract of earlier mention.

Thus Manchoukuo has deemed it advisable to develop several ports and steamship lines instead of planning for the prosperity of Dairen alone, and in consequence it is expected that the authorities concerned will make efforts for the improvement or perfection of the habor facilities at Hulutao and other ports to keep pace with the future development of the new nation.

(3) RIVERS.—In view of the important part the rivers play in the development of the country, the Government is planning to improve the facilities for transportation on the Amur, Sungari, Yalu and Liao Rivers, the operation of which has also been entrusted to the South Manchuria Railway Company. Control of transportation on the Sungari River has already been effected.

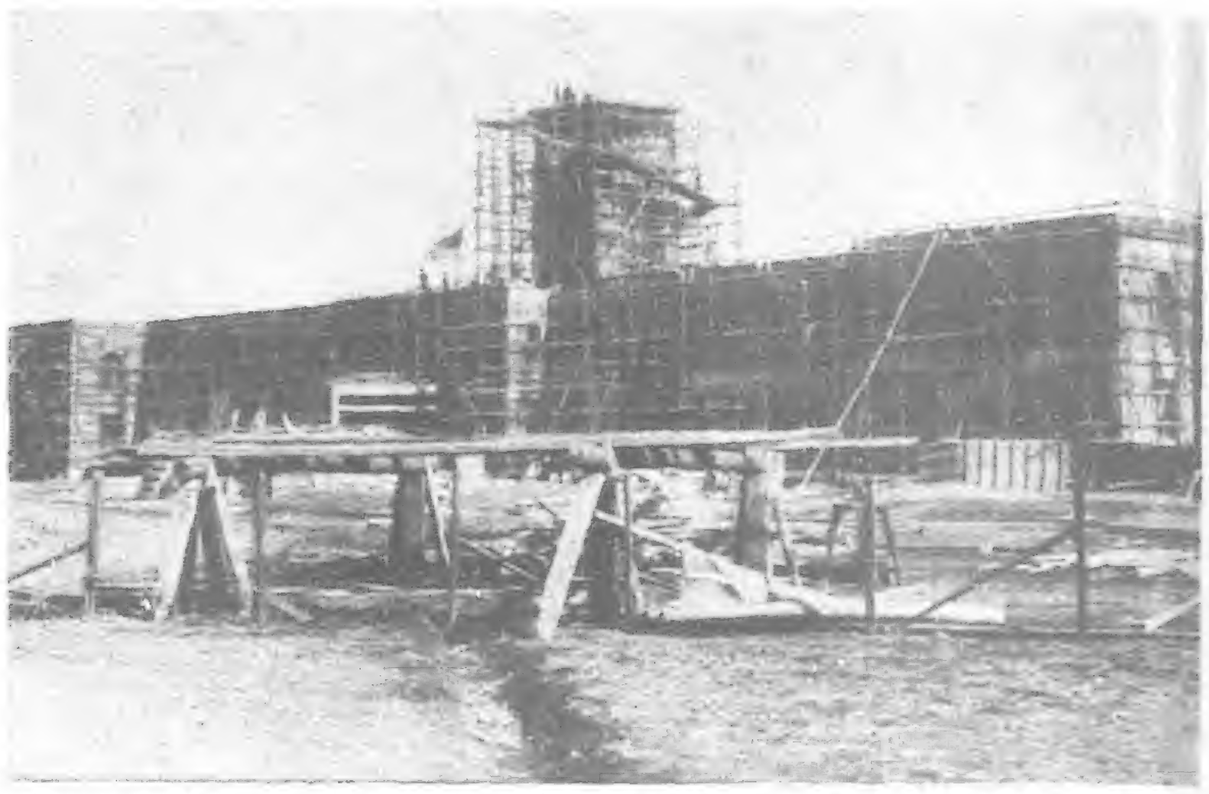
Hsinking is situated some 700 feet above sea-level in the watershed of the vast Manchurian plain. The water flowing north from Hsinking is gathered into the Sungari and that flowing south into the Liao. The Sungari is navigable by steamships for 1,600 kilometers, while junks can sail upstream on the Liao for 300 kilometers. Thus heavy materials can be transported by water a considerable part of the distance to the capital.

The Tumen River rises in Mt. Paitou and is 518 kilometers in length, its tributaries watering the entire district of Chientao, which covers an area of some 45,815 square kilometers. Ships used to sail on the lower reaches of this river, between Hsunjung and Hsiajuping as the sole route of trade with Hunchun, but sailing activity has temporarily declined nowadays owing to the recent construction of a railway in the vicinity and also to scanty production in the district it serves. Researches are now being conducted as to the possibility of harnessing the Tumen and Yalu rivers for electric power.

(4) ROADS.—With a view to facilitating general communications as well as peace preservation, the Government has prepared a ten-year program for improving or building roads of approximately 60,000 kilometers in total length. These roads include highways connecting the provincial capitals, and each of these cities with the capitals of the neighboring *hsiens*, or counties, as well as those necessary for the development of the backward districts or for national defence. For this purpose a sum of 15,000,000 yuan has been set aside from the national foundation loan of 30,000,000 yuan, and work was started in March 1933, with an initial appropriation of 10,000,000 yuan.

In preparing the program attention has been paid to the

Horse Carts being used extensively in Reconstruction Work at Hsinking



One of the many Government Buildings now being Erected at Hsinking

necessity for the roads to stand comparatively permanent use, even in the summer rainy season. At present all roads on the ground level are practically unfit for use during the rainy season, traffic on them being confined to the winter months. The new roads have been provided with two tracks, separated by a trench, one for motor traffic and the other for horsedrawn vehicles, in order to protect the road surface and facilitate traffic. A motor road was built between Ninguta (Ningan-fu) and Tunghua in July, 1932. The Government plans to develop motor traffic on all roads throughout the country in due course.

(5) Post, Telegraph and Telephone Services.—The Government has also planned the unification and co-ordination of the postal services and electric communications, both wired and wireless. This project is steadily materializing daily. In arranging wireless connections between Manchoukuo and foreign countries, Japan has rendered all possible assistance. At present wireless communication is being carried on between Harbin and some cities in China Proper, including Peiping, Tientsin and Shanghai, while the wireless stations at Mukden and Nagoya are relaying messages to and from Europe, and the Mukden and Tokyo stations those to and from the United States, on behalf of the Manchoukuo Government. Radio programs also are being broadcast for local listeners-in at Harbin, Hsinking, Mukden and Dairen.

(6) Air Transportation.—The establishment of a through air route between Asia and Europe, connecting the Moscow-Irkutsk air line of Soviet Russia with the Tokyo-Dairen line of the Japan Air Transport Company, will be welcome to all, while the advantage of aircraft in connecting various cities far removed from each other in the vast plains of Manchuria is also obvious to all, and the inauguration of a regular air transportation service, it was believed, would contribute a great deal towards developing the industries and culture of the country. It is largely for this reason that the Manchuria Air Transportation Company was organized in the autumn of 1932.

This company is capitalized at Y.3,850,000 and is a Japanese-Manchoukuo joint enterprise, the capital having been subscribed by the Manchoukuo Government, the South Manchuria Railway and the Sumitomo Companies. The entire organization is incorporated under the laws of Manchoukuo. This company now operates the following lines, totalling some 5,000 kilometers :

Name of Line	*Principal Intermediary Ports*	*Approximate Length Kilometers*
(1) Japanese-Manchoukuo (between Shingishu in Chosen and Manchouli)	Mukden, Hsinking, Harbin, Tsitsihar and Hailar	1,600
(2) Mukden-Dairen	—	380
(3) Hsinking-Lungchingtsung	Kirin, Tunhua	400
(4) Harbin-Fuchin	—	520
(5) Hsinking-Harbin	Kirin, Hsinchan	390
(6) Mukden-Chengte	Chinchow, Chaoyang	540
(7) Chinchow-Chengte	Chaoyang, Chifeng, Weichang	470
(8) Tsitsihar-Peian	Lahachan	260
(9) Tsitsihar-Heiho	Peian, Lungchen	450

It is planned to establish routes covering an additional 3,500 kilometers within the next three years. Efforts are also being made to open air connections with Europe, as well as with various other parts of the Far East.

Agriculture, Forestry, Stock Farming and Fisheries

That agriculture forms the foundation of the national economy of Manchoukuo is obvious from the fact that between 70 and 80 per cent of the thirty million people of the country are farmers, who own some 34,300,000 acres of cultivated land with a total annual production worth approximately 1,000,000,000 yuan. Moreover, approximately 70 per cent of the total exports of Man-

Showing recently built Modern Residences in Hsinking

New Apartment House at Hsinking built to House Government Officials

Structures within which Departments of the Government of Manchoukuo are Housed

Department of Civil Affairs

Office of the Chief Executive

Departments of Communications and of Industry

The Entrance to the Office of the Chief Executive

Office of the Legislative Council of the Manchoukuo Government

Main Entrance to the Office of the Council of State Affairs

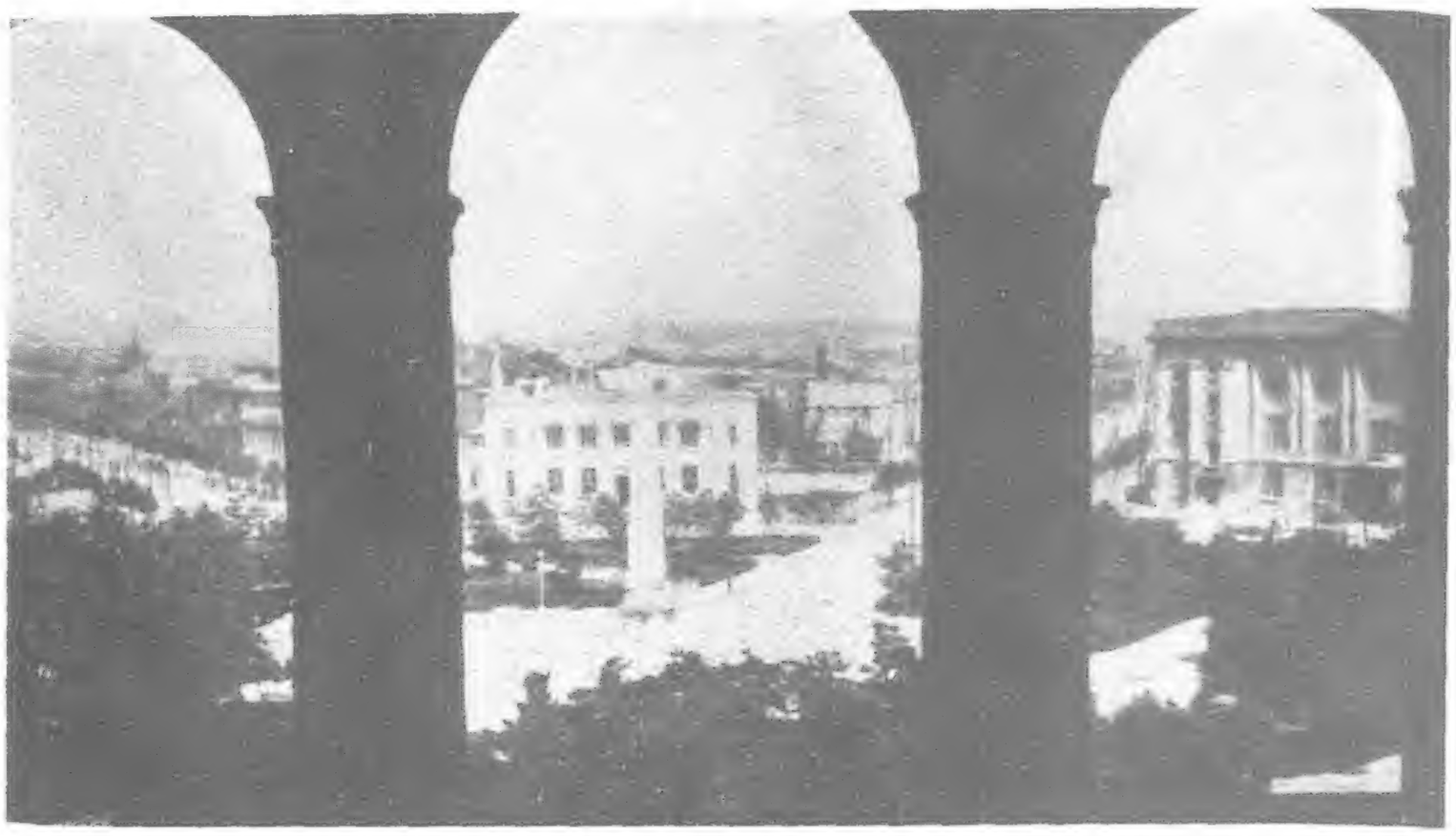
Office of the Prime Minister of the Manchoukuo Government

choukuo amounting to 470,000,000 yuan are agricultural products, which also account for the major portion of internal freight. Nevertheless, agriculture in Manchoukuo is still in its infancy, the methods employed being little in advance of the primitive. Therefore, improvement and development of agriculture are of primary importance in order that the farming masses of the country may have their livelihood stabilized and their welfare promoted. For this purpose, the Government has planned measures of protection and encouragement in order to improve and increase the crops of soya beans, kaoliang, millet, wheat and Indian corn, which are the staple farm products of the country, and to increase the area under cotton cultivation. It has been decided to encourage the cultivation of tobacco, hemp, peanuts, sesame and vegetables, as well as oak silk worm farming, with the object of improving farm management and agricultural economy in general.

With regard to the forestry industry, the Government stresses the importance of controlling unscrupulous lumbering, and of protecting the industry by means of rational management. Lumbering in State-owned forests is carried on under State management as a rule, but free private operation is allowed in public and other forests. Further, proper measures are being planned to encourage afforestation and develop the forestry industry.

Manchoukuo abounds in live-stock of all kinds, but the majority of them are of inferior breeds and are of little value as a national resource. The policy to be followed in future in this connection must therefore aim at improving the breeds and providing hygienic facilities, rather than at a mere increase in the amount of stock. The Government is planning to introduce improvement in the breeds of horses and sheep and to make selections from among the existing breeds of cattle with the object of increasing the stock of superior breeds. Plans are also under way to improve and increase the stock of pigs to meet domestic needs.

As to fishery, the authorities are making efforts to replenish the resources by means of artificial hatching and breeding, while warning the people against unnecessary fishing, in order to conserve the various breeds of fish and shell-fish for future use and to develop the industry as a whole.



Showing the City Park at Mukden from a verandah of the Yamato Hotel

Mining and Manufacturing Industries

In its program for the mining and manufacturing industries, the Government aims at strengthening the national economy and increasing national wealth by developing mineral resources and establishing certain basic manufacturing industries, as well as those calculated to meet the requirements of national defence. The Government is granting concessions to special organizations to utilize such mineral resources as are important for national defence in accordance with the provisions to this end of the Japan-Manchoukuo Protocol, so that their development may be facilitated and the mining operation placed under proper control. Furthermore, measures are being taken to place the production and supply of coal under reasonable control, so that fuel may be supplied at moderate prices and in abundant quantities for the domestic market and its export increased.

The Central Bank of Manchou at Hsinking

Of the alluvial gold deposits and gold mines in Manchoukuo some are owned by the State and others by private organizations or individuals. Those owned by the State are being operated under proper control by specially authorized organizations, but the others are open for utilization by any operators who care to purchase the rights.

The chief mineral deposits in Manchoukuo are estimated as follows: 4,800,000,000 tons of coal, of which, 3,500,000,000 tons are considered to be practically available, including 950,000,000 tons at Fushun and 1,000,000 tons at Hsinti; and approximately 800,000,000 tons of iron ores, for which economic methods of refining are now being studied, including 400,000,000 tons at Anshan, 300,000,000 tons at Kungchiangling and 100,000,000 tons at Penhsihu and Miaoerhkou. The country also abounds in magnesium, aluminium and sulphate of ammonia. The mining of these products is making steady progress under the guidance of the authorities.

Development of the metal, machine, oil fat pulp, soda, alcohol and oak silk worm industries is being planned by the authorities, who also are considering measures to promote cotton spinning, flour milling, cement manufacturing, brewing, etc., in order gradually to meet domestic requirements. Some of these industries are placed under public control while others are left to free operation. All

The City Park Circle at Dairen showing the Yamato Hotel in background at right

On left: **A scene at picturesque Kirin situated on a branch of the Sungari River and** *on right* **a Street Scene in Tsitsihar, Capital of Heilungkiang Province**

industries not mentioned here will be left for the time being to follow their natural development, but it may happen that proper measures will be taken in future to ensure that they are conducted in the public interest.

In order to facilitate the healthy development of manufacturing industries, the Government has decided to establish industrial centers in the vicinities of Mukden, Antung, Harbin and Kirin respectively, in pursuit of a policy of centralization. The electric industry is also to be placed under co-ordinated management in order to make available a cheap supply of power.

The Mukden Military Arsenal is a joint stock company, chiefly engaged in manufacturing arms which was inaugurated in the autumn of 1932 with a capital of 2,000,000 yuan. A cement manufacturing plant was completed at Anshan in March, 1933, to produce 120,000 tons annually, while the annual output of the Showa Foundry at Anshan has now reached 400,000 tons. The Manchuria Chemical Industry Company, which is now being organized at Dairen with a capital of 25,000,000 yuan, will be capable of producing 180,000 tons of ammonia annually. Plans are also under way to produce 4,000 tons of aluminium annually.

Monetary Readjustment and State Finances

Among the innumerable evils practised by the old militarist régime in Manchuria, the one which did the greatest harm was the extortion of the people's wealth through the issuance and circulation of practically inconvertible notes and *pienchih* (kind of currency resembling bank-notes). Immediately after the foundation of the new State, the authorities made up their minds to readjust these currencies. They have already established the Central Bank and arranged for the issuance of national notes, and are now daily proceeding with their plan to effect a satisfactory control of the money market through the stabilization and maintenance of the value of national notes. Moreover, they are now planning to organize a hypothec bank and other financial organizations for the purpose of providing cheap financial accommodation to the masses in various parts of the country.

Some facts with regard to the State finances will be of particular interest. Of the total of 30,000,000 yuan raised in Japan as the National Foundation Loan, which was over-subscribed long before the offer was closed, 15,000,000 yuan has been appropriated for the purpose of road construction, 10,000,000 yuan for pacifying bandits, and the remaining 5,000,000 yuan for relief works following the recent flood disaster.

Much apprehension was entertained both at home and abroad over the prospects of the State finances when the new régime was established, but the situation has been stabilized far more speedily than expected, thanks to the strenuous efforts of the authorities and also to the rich natural resources of the country. Within the first four months after the founding of the new State the Government completed the readjustment of internal taxes and the taking over of the maritime customs and the salt gabelle. During the next three months the Government perfected the organization of its various financial institutions and carried out the compiling of monthly budgets. Thus it was made possible for the first annual budget to be compiled in October, 1932.

In view of the fact that many of the revenue offices under the old militarist régime were in existence only in name, and intermediary agents were in the habit of spending or pocketing a large proportion of the tax revenues, the finance departments of the provincial governments are now in direct charge of the finance of the *hsiens* under their respective jurisdiction to prevent all

The Province of Jehol abounds in Historic Sites. Two views of Old Lama Temples erected hundreds of years ago

possible irregularities. In addition to this, the Revenue Supervision Bureau has been established to supervise the accounts of the various revenue offices.

In the budget for the first fiscal year of Tatung (July 1, 1932—June 30, 1933), the total revenue amounted to approximately 113,300,000 yuan, composed of 97,400,000 yuan in the ordinary account and 15,900,000 in the extraordinary account, while the expenditure amounted to 104,500,000 yuan in the ordinary account and 8,800,000 yuan in the extraordinary account. That pessimism is unwarranted as to the future prospects of the State finances is to be seen from the fact that, apart from the vast untapped resources of the country, the revenue continues to increase with the restoration of peace and order. The unexpectedly favorable results in this connection this year give every reason for believing that it will not be long before the annual revenues reach the 200,000,000 yuan level, although the situation is still such that the new State has to depend upon foreign countries for the supply of a large part of the funds needed for its economic reconstruction.

Cultural and Social Development

(1) Improvement of Education.—Having founded their government according to the principles of *Wang Tao*, the Manchoukuo authorities deemed it of primary importance to acquaint the 30,000,000 people with the ideals of the new nation. For this purpose they instructed all schools in March, 1932, to discard all text-books expounding the party principles of the Kuomintang and to use instead *The Four Books* and *The Book of Filial Piety* by Confucius. Efforts are now being made to revise all other school books and to improve the thoughts of the teachers and students so that they may be fully inspired by the ideals of the new nation. Arrangements have also been made for the teaching of foreign languages and the sending of students abroad in the hope of fostering among the people a better acquaintance with world conditions.

(2) Other Cultural Institutions.—As part of the cultural program, various organizations have been inaugurated for civic, social or cultural purposes. Conspicuous among these are the Manchoukuo Concord Society, the Manchuria Cultural Association, the Scientific Institute of Manchuria, the All-Manchuria Federation of Women, and the Centê (Virtue-promoting) Women's Association, which are now contributing their respective shares to the advancement of civilization throughout the country.

In order to provide more accurate weather information, the Government has decided to erect a central meteorological observatory in Hsinking and seven other local observatories in Mukden, Tsitsihar, Lungchingtsun, Suifenho, Hailar, Heiho and Chifeng respectively. Among other cultural projects are the printing and publication of the *Ssu Ku Chuan Shu* (The Complete Collection of the Four Books), and the encouragement of scientific expeditions for the purpose of excavating the walled city of Tungching and the ancient towns in Jehol. This excavation work is now being carried out steadily by various bodies of scientists and students.

(3) Social Welfare Enterprises.—The Government has adopted city planning projects for Hsinking, Mukden and Harbin, and work is already well under way in Hsinking and Mukden, where steady progress is being made in the construction of government office buildings, factories, boarding-houses, waterworks, sewerage, roads, etc. In co-operation with Japanese organizations, the Manchoukuo authorities are improving the hospital equipment in various cities, giving free medical aid to the poor and otherwise making efforts to provide better medical facilities for the people.

New Bridge at Hangchow

The Chinese Government is considering the construction of a $5,000,000 bridge across the Chientang river, near Hangchow. A high official of the Chekiang Provincial Government, discussing the matter with the Ministry of Railways, has stated that, owing to the heavy traffic across the Chientang, which at the present moment is handled by only a few ferry-boats, the need of a bridge has long been felt and it has increased greatly with the recent completion of a network of provincial and national highways, with Hangchow as the center. Furthermore, a section of the Hang-Kiang railway connecting Ching Hua, Chekiang, with Yu Shan, Kiangsi, is expected to be open to traffic shortly, and it is quite clear that ferry-boat services alone will not be sufficient for traffic across the Chientang.

The Chekiang Provincial Government asked an American engineer to design the proposed bridge, but, owing to certain peculiar local conditions, it is not suitable in its present form. A Chinese bridge engineer, Professor Mao Yi-shen, of Peiyang University, who has been engaged in a study of the project went to Hangchow in April to make investigations and visited Hangchow again recently. He has now submitted a revised design based on the original plans of the American engineer.

The new bridge which will connect Chakou, on the north bank, with Chingkiang, on the south bank, will be two kilometers in length and 40-ft. in width. It will have 130 spans, thirty directly over the river, and will be about twenty feet above the river level. The entire structure will be of steel and reinforced concrete. The lowest estimate for its construction has been placed at $5,000,000, and it will take at least three years to complete.

Developments in Manchuria

Manchoukuo is making great progress in getting all its important industries under State control. Already concerns of ten different kinds have been organized or planned on a joint investment basis, with the Manchoukuo and Japanese Governments dominating them. Dividends of all the companies will be restricted to 10 per cent.

Manchuria Oil Company.—Will be incorporated in the near future, to purchase and refine crude oil.

Manchuria Coal Mining Company.—All coal mining properties in Manchuria, with the exception of those belonging to the Penchihu Coal and Iron Company, an Okura subsidiary, will be merged.

Japan-Manchuria Magnesium Company.—Will make magnesium of Manchurian magnesite.

Japan-Manchuria Aluminium Company.—To make alumina, which will be shipped to Japan for manufacture into aluminium.

Manchuria Chemical Industry Company.—Will manufacture ammonium sulphate.

Manchuria Electric Company.—Will be established shortly to control the electric business of the entire country.

Manchuria Gold Mining Company.—Will conduct placer gold mining in Heilungkiang, Khingan and Kirin Provinces.

Manchuria Alcohol Company.—Will control the alcohol industry.

Japan-Manchoukuo Communications Company.—To control all telephones, telegraphs and radios.

Manchuria Aviation Company.—Already operating, with a monopoly of all business.

Mention is not made of the railway bureau, which controls all the rail communication in the country through the South Manchuria Railway, or of the Showa Steel Works, which includes all the iron and steel making except that of the Okura interests.

Announcement has been made that private enterprises which wish to enter Manchoukuo must obtain licenses. Portland cement is to be one industry which the Government does not intend to control entirely. A hemp company is likely to be established either in Harbin or some other city of North Manchuria. The Manchoukuo Government will encourage a private Japanese company to start a motor bus company. A Japanese sake brewery is being built in a Mukden suburb. Some of the placer gold mining sites will be left open for private exploitation.

A sum of $10,000,000 is to be spent by the Government of Manchoukuo during the year beginning July 1, for assisting industry. Among projects contemplated is the construction of a central meteorological observatory at Changchun at a cost of approximately Y.300,000.

The Liu Ho Kow Blast Furnace Plant, Hankow*

T. C. CHEN, Resident Engineer

Of all the substances, iron and steel are basic materials without which no industry can exist. From needles to gigantic battleships, approximately ninety-nine per cent of all steel owes its origin to pig-iron, the product of a blast furnace. Thus one can clearly understand the unique position which the blast furnace occupies among engineering projects.

In view of the fact that the annual consumption of iron and steel *per capita* forms the measure of civilization of a nation, it is surprising to learn that, since Hanyang Iron and Steel Works and Tayeh Blast Furnaces have become historical relics, the Liu Ho Kou Mining Company's Blast Furnace Plant, situated at Seven Mile Creek, near Hankow is the only place in China where pig-iron is manufactured according to modern methods. Consequently one would assume that the Liu Ho Kou Blast Furnace should have prospered with almost a monopoly. But on the contrary there has been a struggle through civil wars, communists' riots, interruption of railway traffic, foreign aggression and dumping, famine, disastrous flood, trade depressions, etc., for the last ten years so that its very existence is now being threatened. This mining plant can serve the nation as a nucleus for the future iron and steel enterprises and also as a training institution to produce ferrous metallurgists who will be destined to develop China's enormous iron deposits.

The plant was originally built and owned by the Yangtze Engineering Works and its excavation work was started in the winter of 1918. After the completion of the construction work, the furnace was blown-in on May 22, 1920, but owing to financial stringency and consequent insufficient supply of raw materials, there were repeated interruptions of operation during the years 1920 and 1921. On August 1, 1922, the Liu Ho Kou Mining Company took over this plant and the furnace resumed production of pig-iron on October 12 of the same year. The furnace was remodelled according to new design in 1924 and has been operated satisfactorily ever since.

TABLE SHOWING DIFFERENT WORKING PERIODS AND TONNAGE OF PRODUCTS

Date of blowing in	*Date of blowing out*	*Cause of Shutdown*	*No. of tons of pig-iron produced*
Oct. 12, '22	Oct. 14, '23	Relined for water leaking in through the bosh wall	27,975
Dec. 6, '23	May 9, '24	Bosh wall reconstructed with thicker brickwork	12,232
Aug. 15, '24	Nov. 5, '24	The declaration of the 2nd war between Chihli and Mukden warlords	5,831
June 15, '26	Jan. 26, '26	War between the joint forces of Generals Chang and Wu against General Feng	17,090
June 6, '26	Sept. 4, '26	The arrival of the Revolutionary Army of the Nationalist Government at Wuhan	5,541
Oct. 11, '28	June 24, '29	The expedition of the central government forces against the Kwangsi troops followed by the fighting against Generals Yen and Feng	17,534
Nov. 17, '31	Sept. 5, '32	Relining for water leaking in through hearth wall	23,331

As the standard of living grows higher and higher, year after year, the direct and indirect costs of manufacture in this plant are greatly affected. In September 1924 and March 1932, the working conditions were similar but the cost per ton of pig-iron was considerably different.

Time	*No. of days in operation*	*Kind of coke used*	*No. of tons of pig-iron produced*	*Cost per ton of pig-iron*
Sept., 1924	30	L.H.K.	2434.2614	26.37 taels or $37.34
March, 1932	31	95% L.H.K. 5% Hunan	2699.5763	$68.37

The quality of pig-iron made during the different operations was in accordance with the requirements of the market. Usually, only first grade foundry iron is desired. During the last operation, 23,331 tons of pig-iron were produced of which 20,369 tons were No. 1 foundry, a little over 87 per cent of the total.

This plant is equipped with six important parts: the furnace proper, hot blast stoves, blowing engines, hoisting engines, boiler plant and water tower. For convenience, they are described under separate heads as follows:

The Furnace.—The furnace with a rated capacity of 100 tons of pig-iron per 24 hours consists essentially of an enclosed space, called shaft and bosh, for reducing and melting the raw materials charged in, and a crucible for collecting the molten iron thus produced. The crucible, technically known as hearth, is cylindrical in form, with a diameter of seven feet nine inch and a height of about six feet. It is built with the most refractory firebrick and laid upon heavy foundations. The thick brickwork is further encircled by strong riveted steel plates cooled externally by water sprays. The top part of the hearth from the hearth jacket to the bottom of the bosh wall, known as "tuyere breast," is lined with a thinner brick wall, reinforced by circumferential steel bands and cooled by bronze cooling plates inserted into the brickwork. For thorough cooling to prevent

*Journal of the Association of Chinese and American Engineers.

General view of the blast furnace plant

The office building

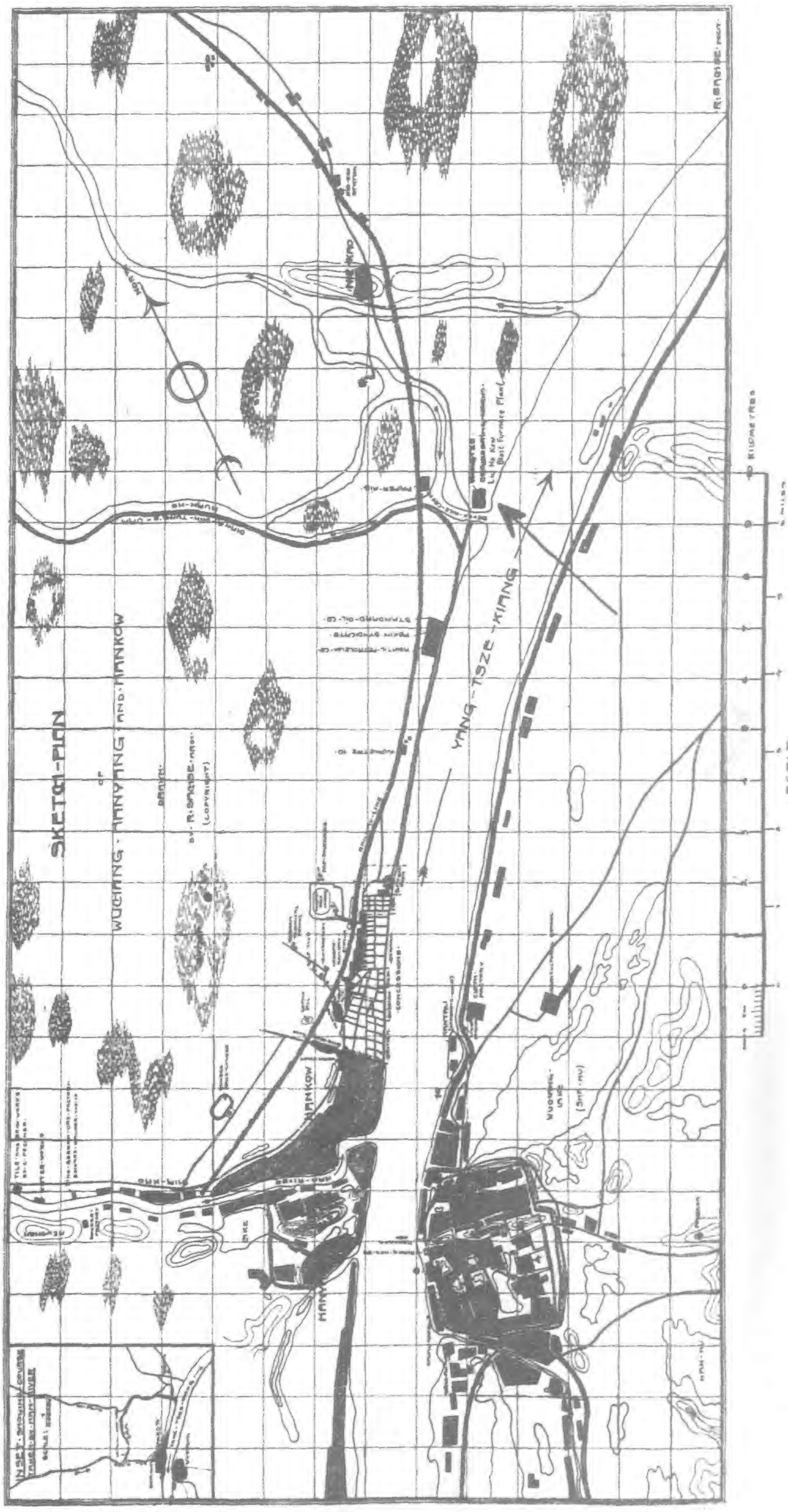
erosion of the brickwork, water sprays are also provided around this region. On top of the "tuyere breast" comes the bosh which has the shape of an inverted conico frustrum. It is about 10 feet high and has a greatest diameter of 12½ feet. This part has a similar construction to that of the "tuyere breast" except that the brickwall is built sloping with a gradually increasing diameter corresponding to its height. The shaft of the furnace is also in the form of a conica frustrum placed directly over the top of the bosh. It has a height of about fifty feet and a throat diameter of nine feet. It is enclosed in a riveted steel plate shell with a fire brick lining resting upon a mantle supported by six cast iron columns.

In front of the furnace, there is a tapping hole provided for the removal of the molten iron. The hole about six inches square is located near the bottom of the hearth. On both sides of the furnace there are provided two other openings for the removal of slag known as cinder notches. They are set at 180 degrees apart and at a position about two feet above the tapping hole. As they undergo high temperature during flushing, they are protected by a series of bronze coolers of different sizes. The cinder flows out from the smallest cooler, about 1½ inch in diameter, which is stopped by an iron plug covered with a layer of clay. In the "tuyere breast," there are six "tuyere" openings, set 60 degrees apart for the admission of blast. The "tuyeres" are made of bronze and of similar shape to the coolers. In order to resist the high temperatures, each "tuyere" is protected by a cooler. Connected to the "tuyeres," there is a horizontal cast iron pipe, known as blow pipe, which in turn is fastened to a gooseneck pipe called "tuyere" stock. The blast or air is forced in through the blast main to the circular pipe or bustle pipe where it is distributed through the "tuyere" stock, blow pipe, and "tuyere" to the furnace.

The top of the furnace is of the double bell system. Both bells are actuated through lever arms which are operated by two steam cylinders on one side of the furnace. In charging, the small or upper bell and large or lower bell are opened and closed alternately in order to prevent the escape of the combustible furnace gas. The entrained furnace gas is led down through a steel pipe called downcomer to a dustcatcher where it gets a sudden increase in volume, hence a decrease in velocity, allowing the dust particles carried by the gas to settle and be removed. For further cleaning of the gas, a whirler is provided which has the same effect but is more efficient than the former and is constructed upon different principles.

Hot Stoves.—The hot stove is used to heat the blast before its entry into the furnace. As the stoves must be heated and put on service alternately, four are provided for this furnace. They have cylindrical bodies and dome-shaped tops each with a diameter of 14 feet and a total height of about 60 feet. The stove is of the side combustion type with the combustion chamber on one side and the checker work on the other. Both are lined with fire-brick and a heavy division wall is set between them. The heavy brick wall encircling the combustion chamber and the checker work is further strengthened by a steel plate shell strongly riveted. The stove is heated by burning gas in the combustion chamber allowing the products of combustion to rise up to the top, pass down th ough the flues of the checker work, and then discharge to the chimney. The burnt gas gives up its heat to the checker work where it is stored for heating the cold blast introduced later in the reverse course. For ordinary practice, only three stoves are used while the other one is left fo cleaning. Each stove, after two hours heating, is put on servic for one hour. The temperature of the heated blast generall ranges from 1,100 degrees F. to 1,400 degrees F. As dust and dir carried by the gas accumulate very quickly, the stove is usuall cleaned after three weeks of service.

Blowing Engine House.—Blowing engines are used to force th blast into the furnace. There are three blowing engines provided fo this furnace. In usual practice only two of them are in use whil



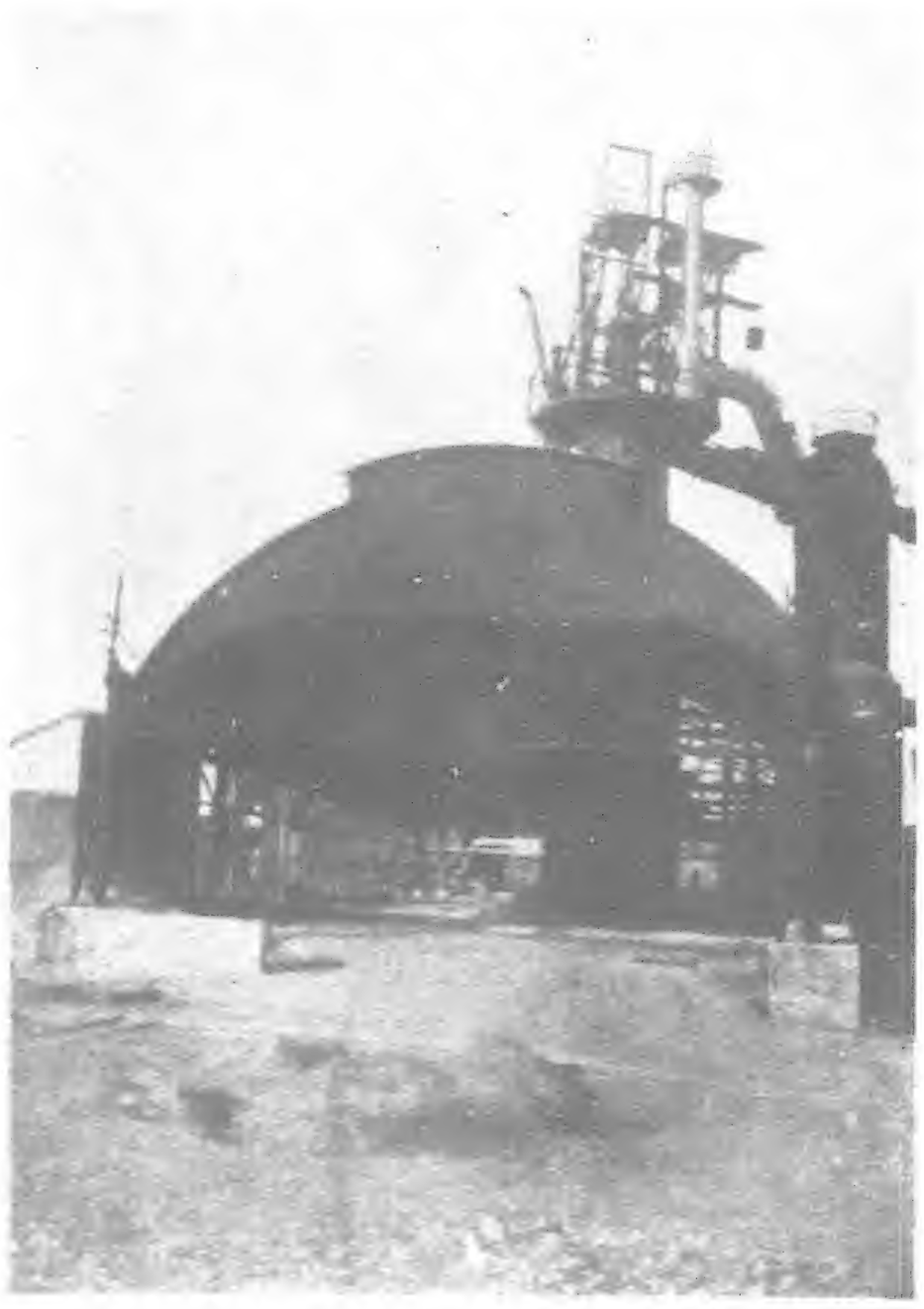
the other one is reserved as a spare. They are all of the horizontal type driven by compound steam engines. But in capacity and construction, none is the same as the other.

No. 1 blowing engine is the smallest and is of the compound tandem type. It is arranged with the low pressure and high pressure steam cylinders in one straight line and the two air cylinders in another line side by side with the former. Set between them is a large grooved flywheel driven by two crank discs connected to the piston rods by connecting rods. Sliding valves are used for steam inlet and exhaust.

No. 2 blowing engine is larger than No. 1 but smaller than No. 3. These two larger engines are similar in construction. They have the high pressure and low pressure steam cylinders each in line with an air cylinder. The two common piston rods of the steam and air cylinders are connected to crank discs whereby the fly wheel is driven. The only difference between these two is the type of their steam valves. No. 2 blower has a type of piston valves and No. 3 is of the Corliss type. In capacity, No. 3 is the largest, while No. 1 is the smallest. At ordinary speed, say 36 r.p.m., No. 3 has a capacity of 4,540 cubic feet of air per minute, while No. 2 and No. 1 have capacities of 3,960 and 3,380 cubic feet of air per minute respectively.

On the outside of the blowing engine house, there are established a pair of air coolers and an air receiver. The air cooler is in the form of a cylindrical tower with water pipes inside. The air goes in from the top, is cooled by the cold water pipes and sucked to the blowing engines. The cooled air has a lower moisture content which is beneficial to the furnace operation. The air receiver is nothing more than a steel tank connected to the cold blast main. It is put in place for eliminating the pulsation action of air from the reciprocating engines.

Generator.—On one end of the blowing engine room, there are erected two D.C. generators. One of them is driven by a vertical steam engine while the other is driven by a three cylinder Diesel engine. The steam engine generator has a power of 200 k.w. producing a voltage of 400. The Diesel engine generator is only half as big, producing a voltage of 220. The electricity generated is mostly used for lighting and as an auxiliary source of power for pumping and various other purposes. For normal service only one generator is used while the other is used as a spare.



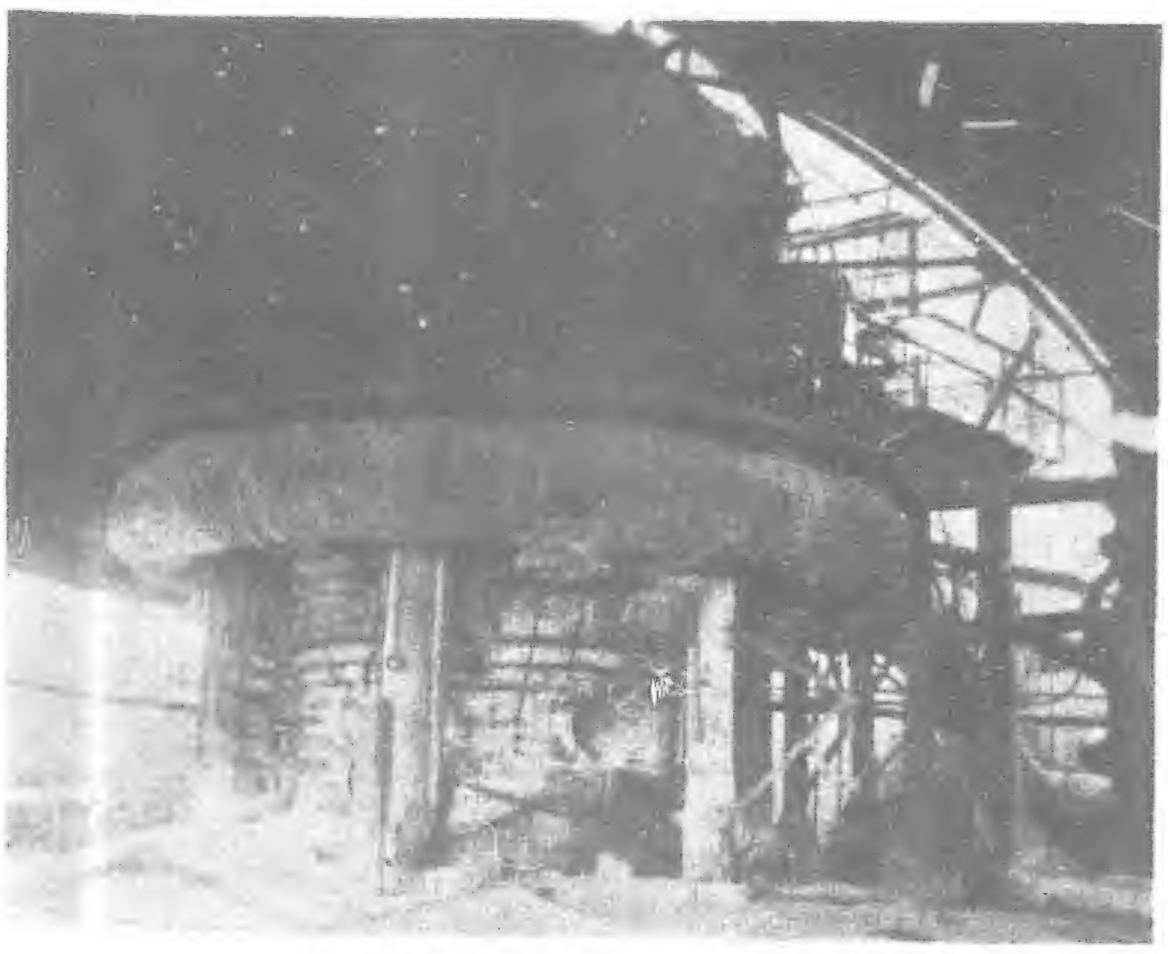
The casting house

Repair Shop.—At the very end of the blowing engine room a small room is provided as the repair shop in which are set a lathe driven by a vertical steam engine and some simple apparatus for doing drilling and bench work. Between the blowing engine room and the boiler house a blacksmith shop and a foundry shop are provided. There are two blacksmith's furnaces and two cupolas and also crucibles of different sizes for founding copper and bronze articles.

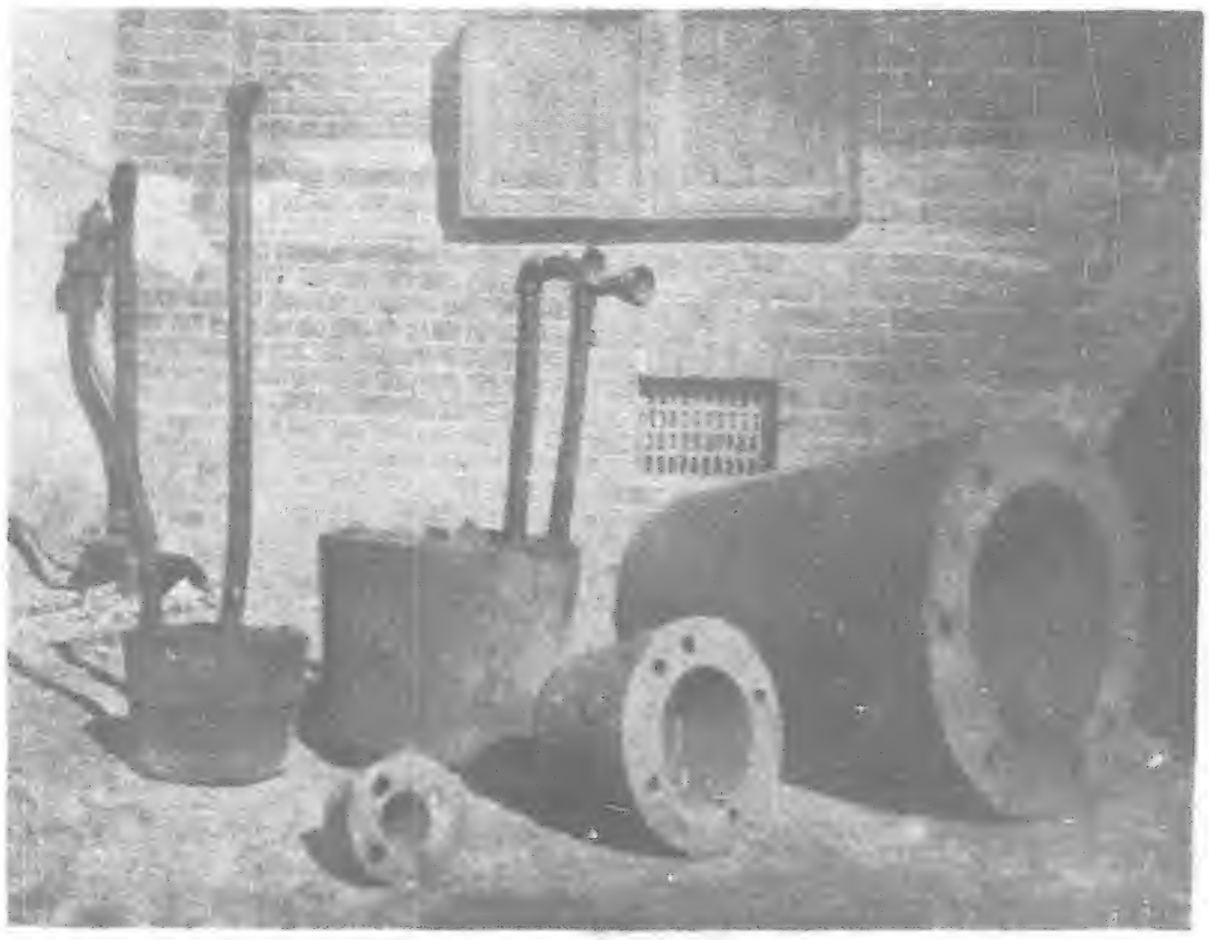
Hoisting Engines.—This furnace is provided with two 45 h.p. hoisting engines running with one common rope drum on which the wire rope is wound. This drum is mounted on a heavy shaft and is driven by the steam engines through gears. The two steam engines are arranged side by side and each is equipped with a fly wheel driven by two steam cylinders. Each engine can be separated off as reserve by loosening the main shaft from the winding drum which is connected to both engines by heavy flanges and bolts.

Hoisting is done by the skip system. On the back of the furnace a single track skip bridge is situated. The bridge is made of steel structure and at an inclination of about 60 degrees. It rests on a heavy concrete foundation at the bottom and is supported at the top by struts which bear on the top of the furnace. At the foot of the bridge, there is a depression (skip pit) for the skip car into which the stock is dumped through a steel plate chute. In charging, the skip is loaded by hand carriages, hoisted up by the engine, and dumped automatically to the hopper provided on top of the small bell. For economy of power, a balancing tower is constructed at one side of the hoisting engine room. The balancing weights supported by the tower are of approximately three to four times the weight of the skip car and its load and is so arranged as to neutralize the weight of the empty car in its upward journey so that the power consumed is only that required to lift up the stock. Reversing gears, wooden brakes, and a tell tail are all provided, to facilitate the running of the engines.

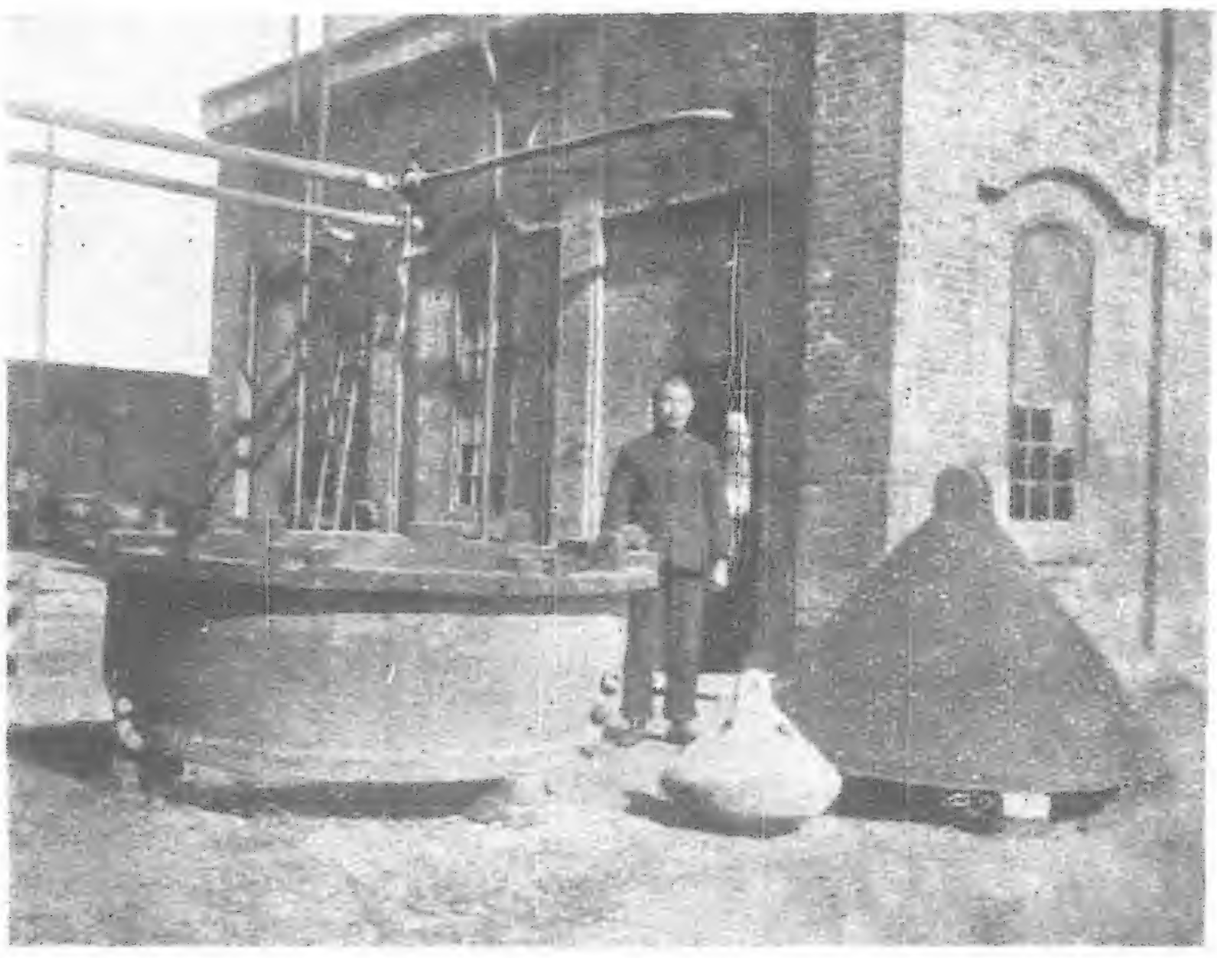
Boiler Plant.—The boiler plant furnishes the power for blowing the blast, pumping the water, hoisting the stock, and also for furnishing the electricity for power and lighting purpose. There are six boilers in this plant arranged in a straight line. They are all of the modified Babcock and Wilcox type without superheater. Each is provided with two water drums on top and twelve bundles of



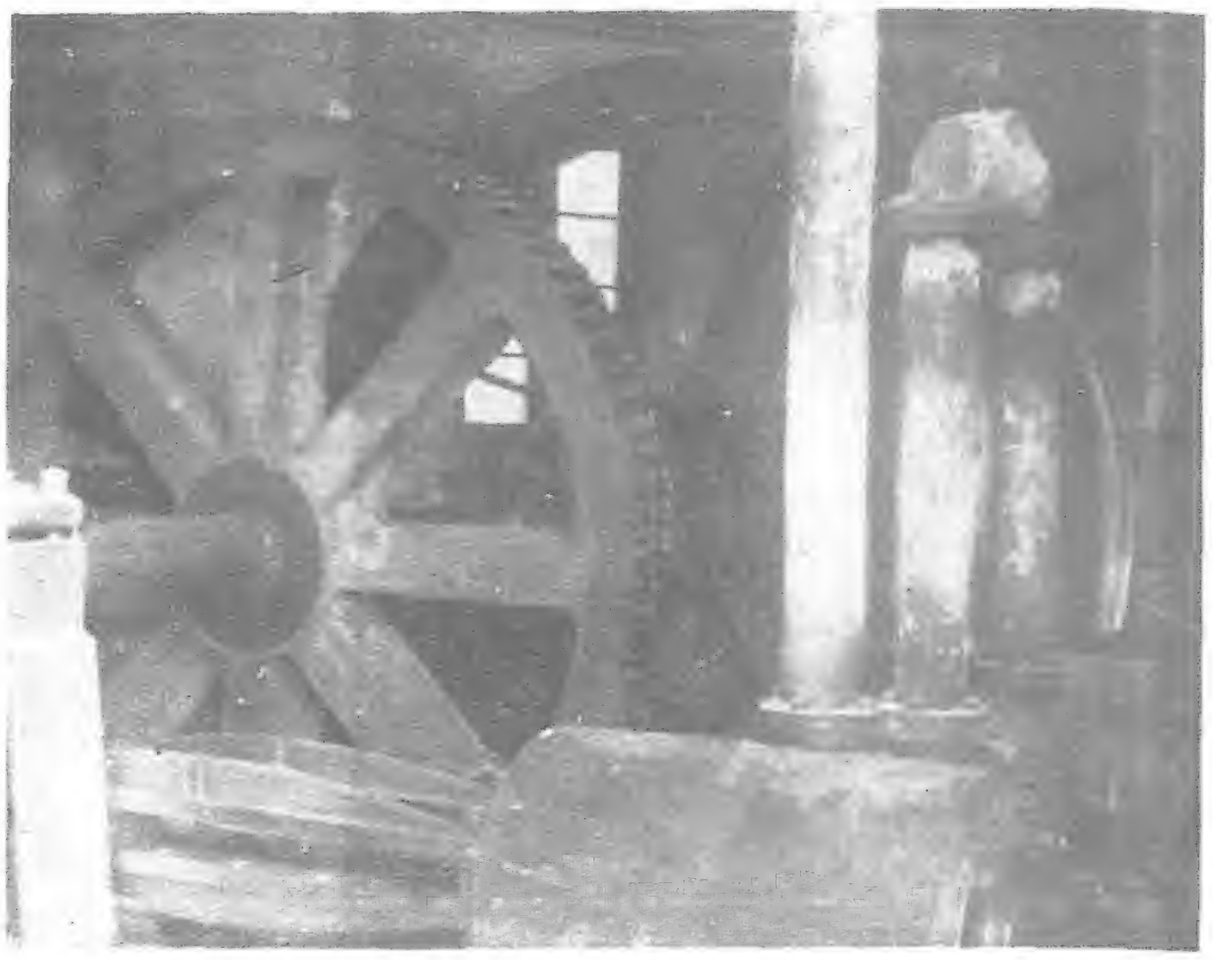
The blast furnace



The bronze coolers made in the plant



Cast iron furnace big bell and hopper extension made in the plant



The hoisting engines

water tubes below, with a total heating surface of 1,700 square feet. The chief fuel used is furnace gas but fire grates are also provided on both sides as coal is a necessary auxiliary fuel for emergency and when blowing-in while no gas can be utilized. For proper regulation of gas stream and air draft, gas burners and also dampers are inserted in gas pipes and chimney flues. Under normal conditions only four boilers are in use while the other two are set off for cleaning and repairing.

At the front side of the boiler house, there are located three feed pumps. One of them is of the vertical weir type while the other two are horizontal. The water is sucked in from a hot well and forced into the water drums after passing through a filter.

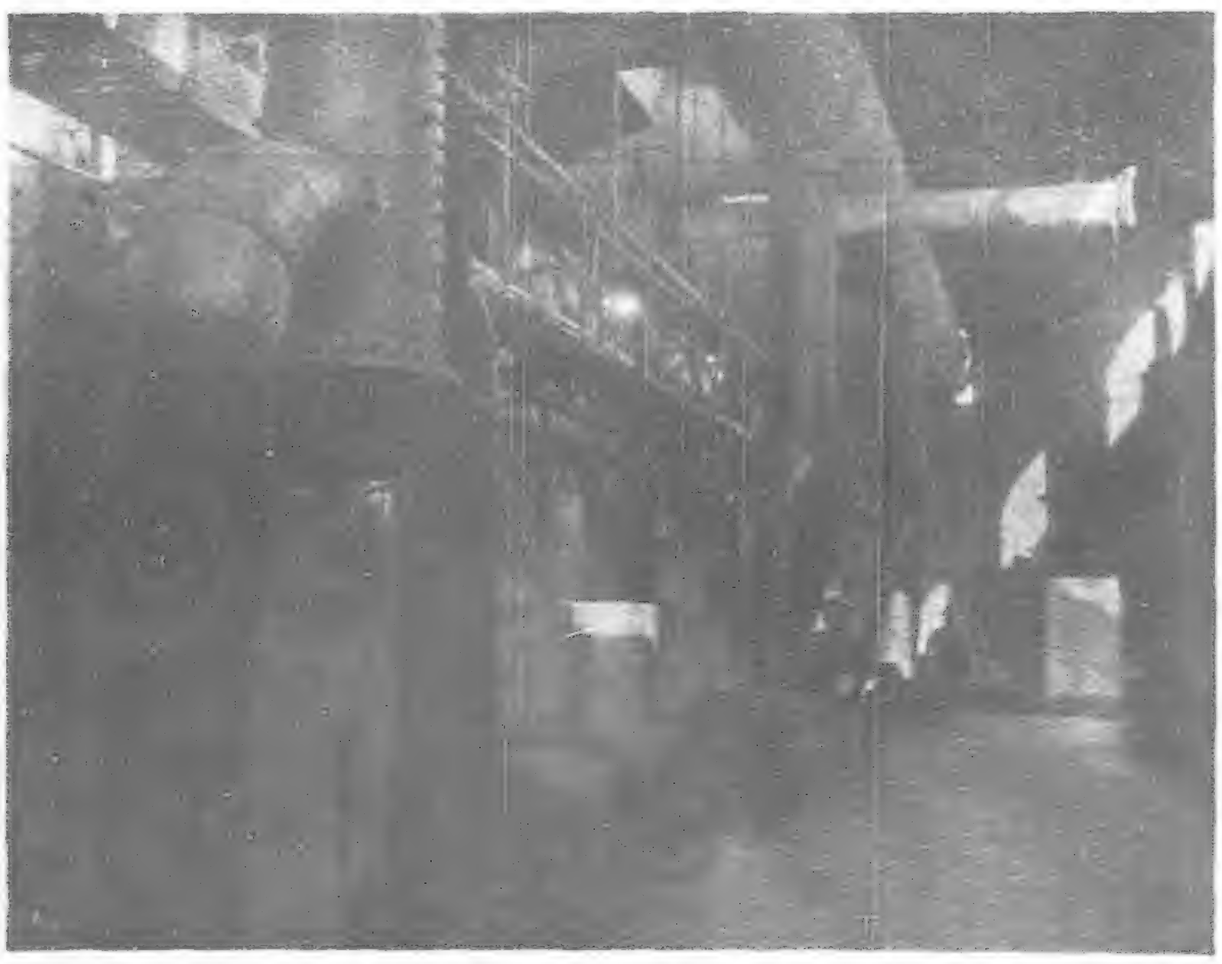
Water Tower.—This water tower supplies the water for the furnace, the hot stoves, the boilers, and also for various other purposes. In this plant, the water tower is built wholly with ferro-concrete. The cylindrical tank has a diameter of about 30 feet and is 25 feet high. It is

The skip bridge and hot stoves

supported by four reinforced concrete columns at a height of about 90 feet above the ground level. The water supply is derived from two sources, the cooling pond and the water reservoir and supplemented by the water from the river.

At the foot of the tower a pump house is situated in which five pumps are set. Four of them are the double acting Worthington type steam pumps while the other one is a single stage centrifugal pump driven by a 15 h.p. D.C. motor. The four steam pumps, though similar in shape are not the same in capacity, one being large, one medium and two small. For usual service only one large steam pump and one small one are run, the others being held as reserves.

Beside the aforesaid six parts there is also a chemical laboratory for analyzing raw materials such as iron ore, limestone, coke, manganese ore and furnace products such as pig-iron, and slag and other substances. Apparatus for qualitative and quantitative analyses necessary for a blast furnace plant are adequately provided.



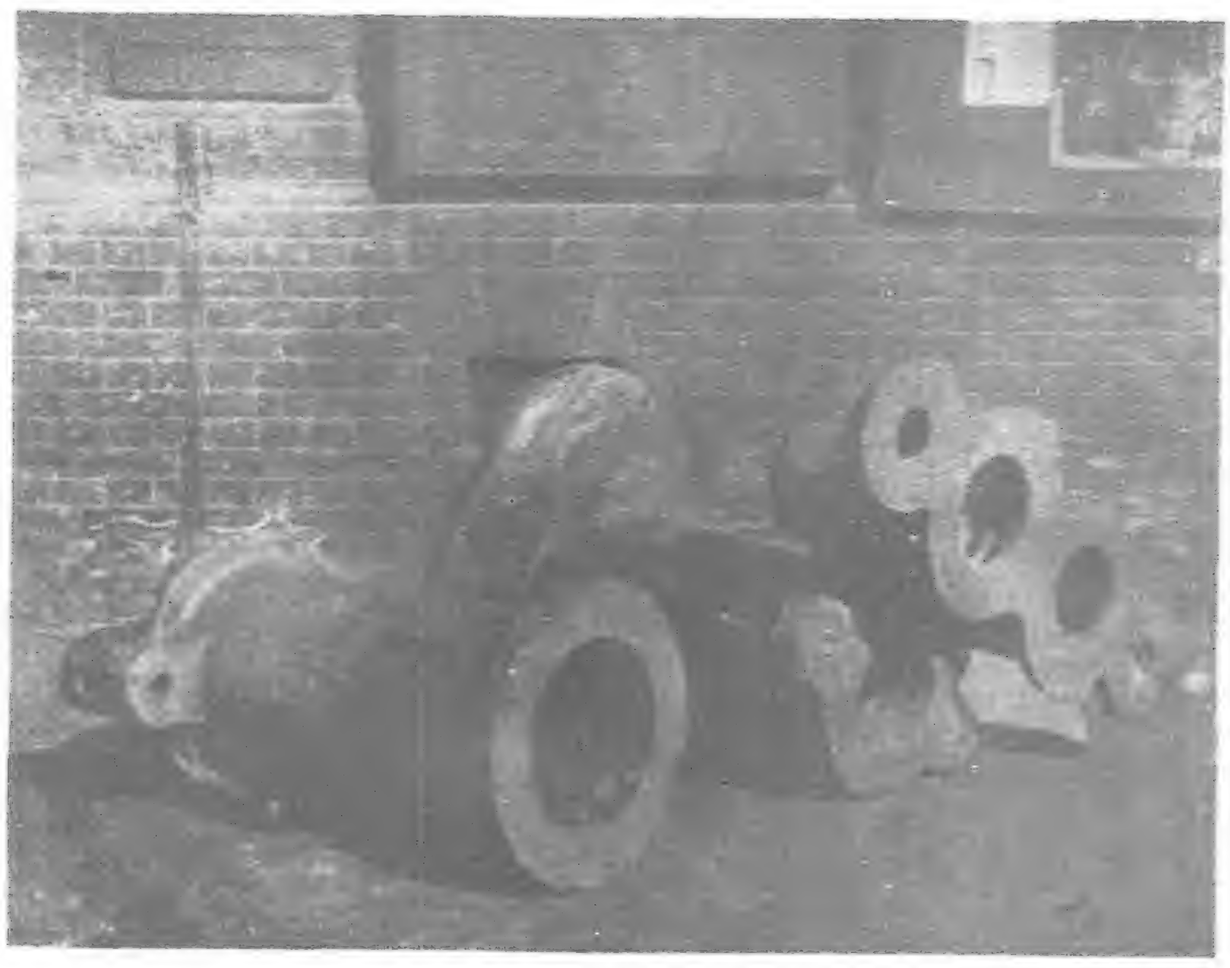
The steam boilers

The water tower pumps

The stock yard, stocking 6,000 tons of coke, 12,749 tons of iron ore, 172 tons of manganese ore and 1,882 tons of limestone

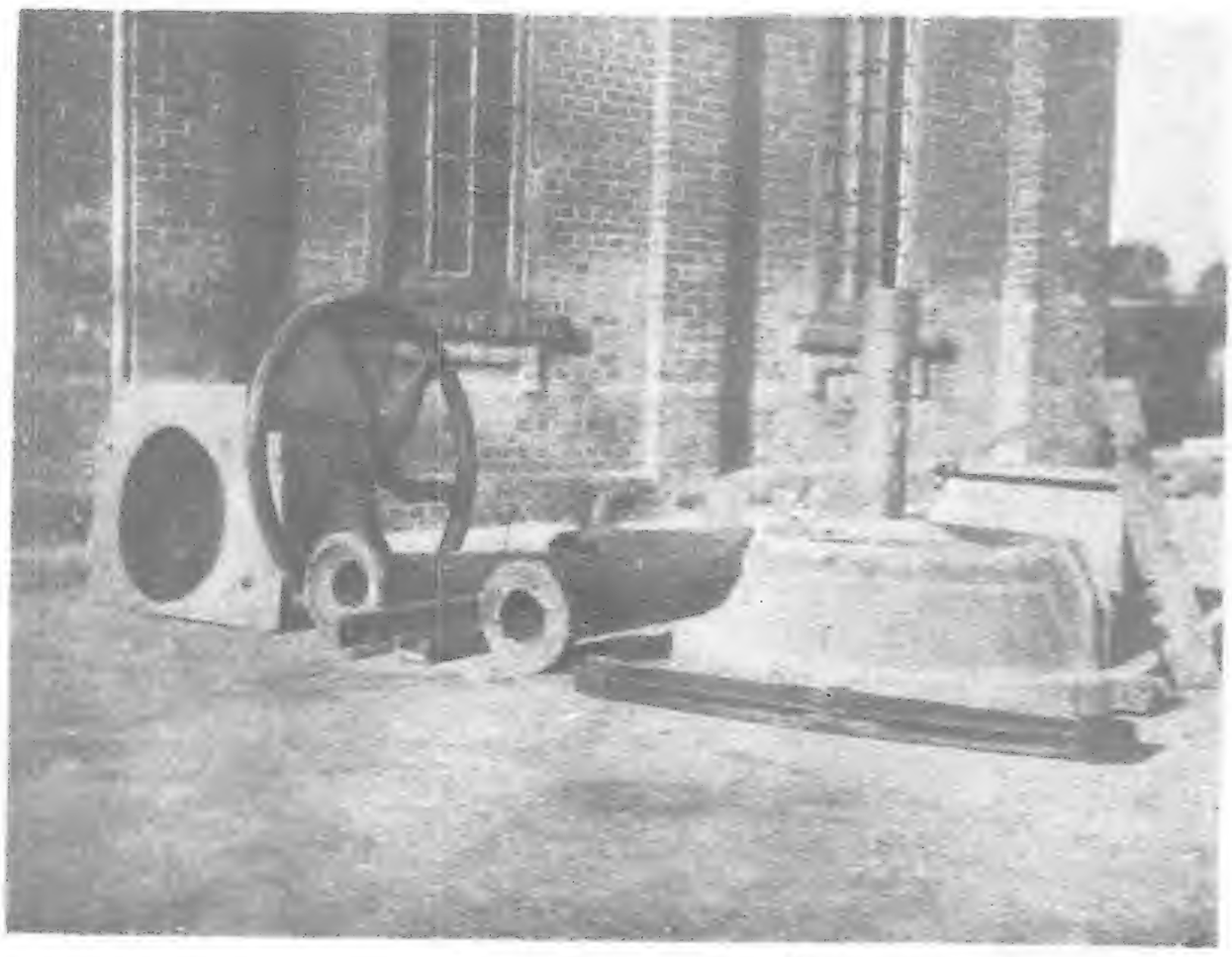
The wharf showing the partially completed bund

The cast iron steam radiators



The cast iron weir pump cylinders

The staff quarters



The cast iron fire grate bars, tuyere box blow pipe, water pipe and hand buggy wheel

Large Sulzer Diesel Engine is Built for Shanghai Power Station

13,700 B.H.P. Maximum Output Double-Acting, Two-Cycle

In September 1933, a double-acting two-cycle Diesel engine of 13,700 b.h.p. maximum output was tested at the works of Sulzer Brothers Limited, Winterthur. The engine was ordered by the Compagnie Française de Tramways et d'Eclairage Electriques de Shanghai, Paris, for their power station in Shanghai and will serve, together with the eight single-acting Sulzer engines already installed, at that power station providing electric energy in the French Concession. The steadily increasing demand for electricity has rendered this extension of the plant necessary.* The current is used principally for lighting and for tramway working, so that the daily load curve shows abrupt fluctuations and high peaks. For service under such conditions the Diesel engine is particularly suitable, with regard both to its ready operation and its economy. It provides also the means of gradually enlarging a power station in accordance with a growing demand for electricity.

The new engine (fig. 1) is similar in construction to the double-acting Sulzer Diesel engines already built for marine and stationary purposes. The principal data are as follows:

Continuous output	11,400 b.h.p.
Maximum output	13,700 ,,
Speed	136 r.p.m.
Number of cylinders	8
Bore	760 mm.
Stroke	1,200 ,,
Output of generator	8,000 kw.
Voltage	5,200-volts.
Frequency	50 periods.

Fuel injection is by air, supplied by two three-stage compressors on the engine (Fig. 2). This method of injection was adopted with regard to the use of fuel with a high asphalt content. The scavenging air is provided by a double-acting tandem pump integral with the engine. Attendance is thus considerably simplified in comparison with plants employing electric blowers, and operation of the engine is rendered independent of the electric supply. The

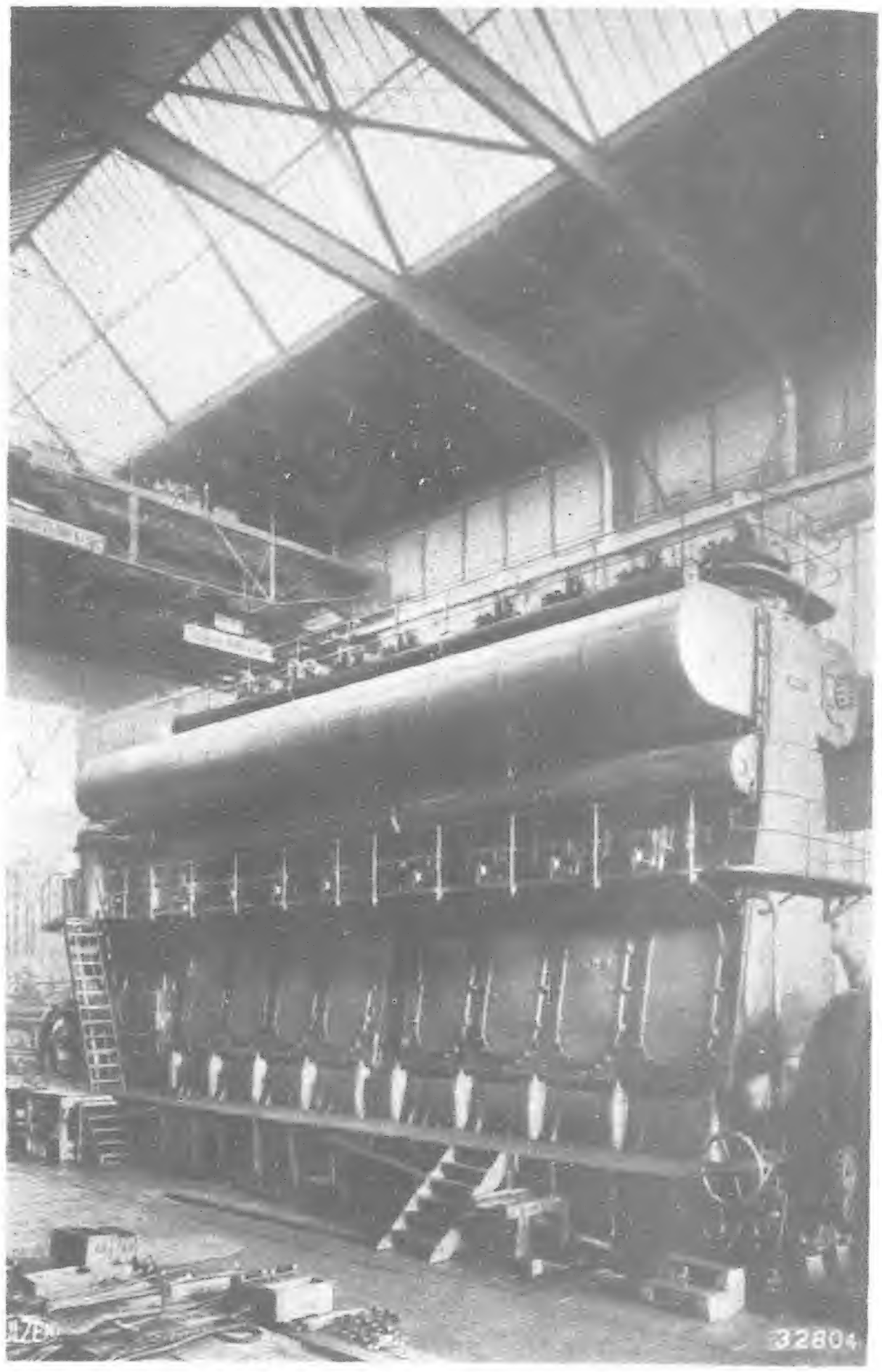


Fig. 1.—The 13,700 b.h.p. Double-acting two-stroke Sulzer engine on test bed, exhaust side

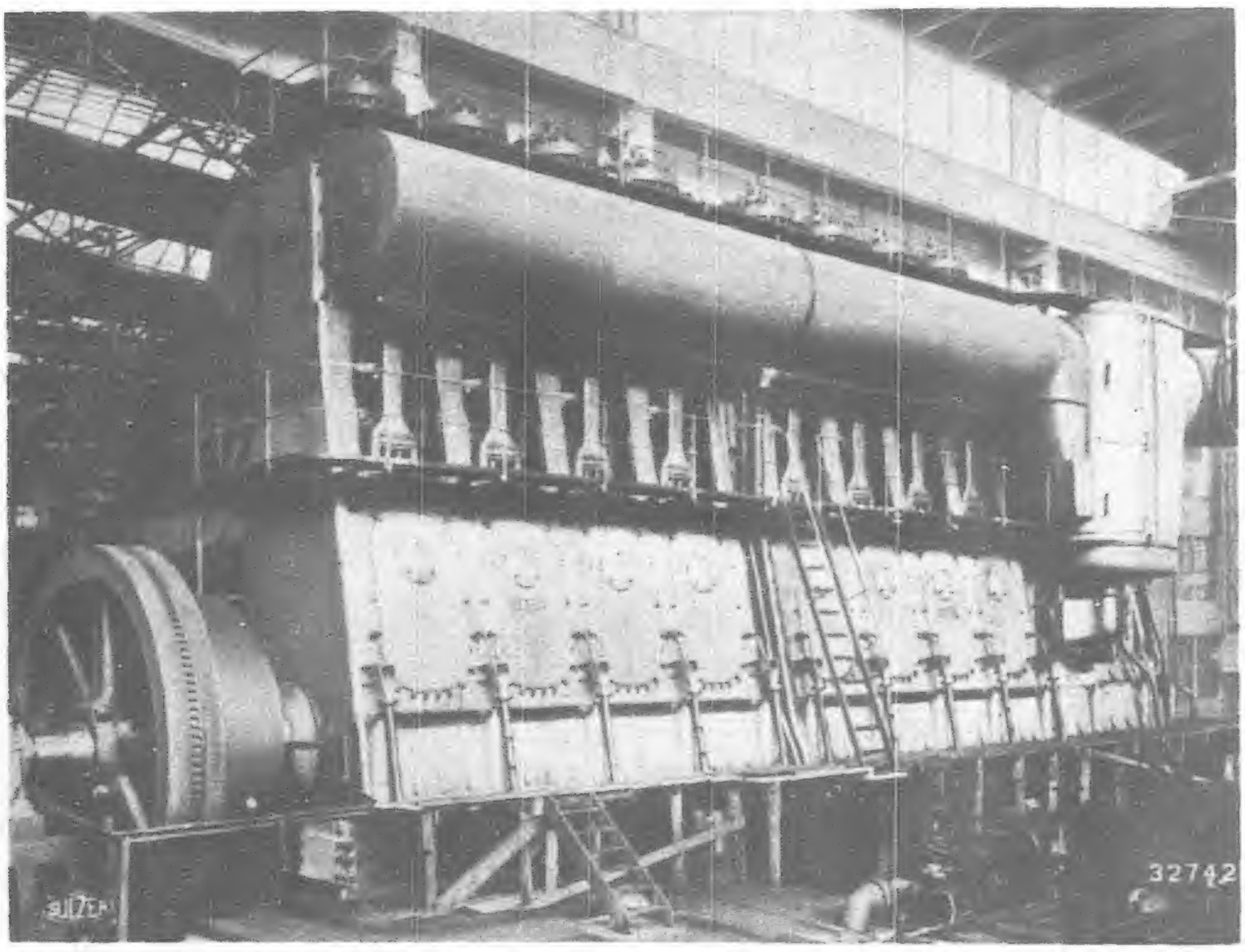


Fig. 2.—The 13,700 b.h.p. Double-acting, two-stroke Sulzer engine on test bed, scavenging side

direct coupled three-phase alternator, constructed by Messrs. Alsthom in Belfort, is self-ventilating and capable of working continuously at an outside temperature of 45°C (113°F). With a load factor varying between 0.65 and 0.85, the generator may be overloaded by 25 per cent. The exciter is mounted on the free end of the generator shaft.

Engine Construction

In a general survey of the engine construction, a striking feature is the extremely rigid framework, peculiar to Sulzer engines, resulting from the design of the columns and cylinder blocks (Figs. 3, 4 and 5). This factor is of particular importance in the present case, where the foundations of the plant rest on soft ground and are planned with a view to light specific loading of the subsoil.

At the upper cylinder end fuel is introduced into the combustion space through a central fuel valve. The cylinder head, which is very simple and has the shape of a solid of revolution, is held down on the block by a steel ring and bolts. The lower combustion space has two pockets in the cylinder cover, at the lowest and coolest points of which are the fuel valves. A

*The population of the French Concession in Shanghai (500,000 inhabitants) has been regularly increasing by about 20,000 yearly.

safety valve and the pneumatically operated starting valve are also situated in the lower cylinder cover. All valves are arranged with vertical axes so as to obviate uneven wear, and are easily accessible. The camshaft is on the exhaust side of the engine, at about half engine height, and driven by screw gearing from the crankshaft at its middle. The fuel valves are operated by tie rods. The lift of the fuel valve needles is automatically regulated, in accordance with the load, by means of mechanism varying the position of the roller link with regard to the cam.

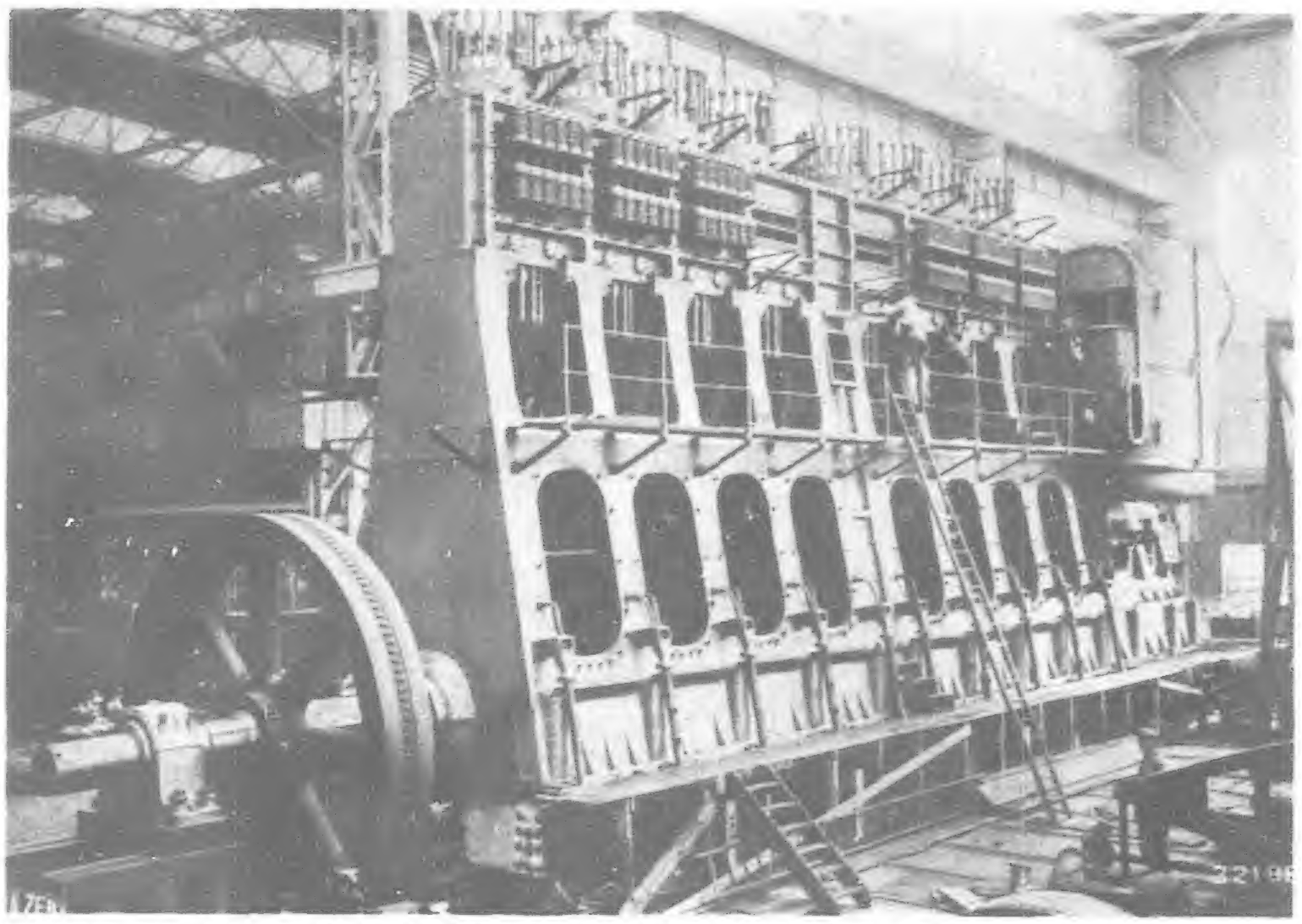


Fig. 3.—The 13,700 Double-acting, two-stroke Sulzer engine during erection

Outstanding Features

Since a detailed description of the engine is not here possible, it is proposed to describe some interesting features.

The main piston (Figs. 8 and 9) consists of three parts, the top and bottom parts being bolted, together with the cast-iron sleeve, to the piston rod flange.

The piston rod is of high-grade Siemens-Martin steel and joined with the crosshead by means of special opposed nuts, permitting simple adjustment of the compression and even distribution of stresses. An exterior sleeve of hard cast iron protects the rod from wear or contact with hot gases, and is fastened to the piston at its upper end, the lower being free for expansion. The piston cooling water enters by the annular space thus formed and leaves by an axial passage in the rod. No contact with the rod, however, takes place since the latter is surrounded as well as lined with protective tubing. The cooling of the outside sleeve with water is very beneficial for the stuffing-box, which remains cool and well-lubricated and therefore gastight.

Scavenging of the lower combustion chamber is not interfered with by the piston rod. Owing to the design of the ports, the air descends in a united stream on the admission side, to pass the points rod near the cylinder cover and then to rise to the exhaust ports. The combustion pockets are at the same time effectively swept. The course taken, as determined by actual experiment, is illustrated in Fig. 10. Analyses of the cylinder contents (for the release of which special valves were incorporated) have shown that the scavenging efficiency is as high for the lower as for the upper combustion chambers and amounts to 96-97 per cent according to the load.

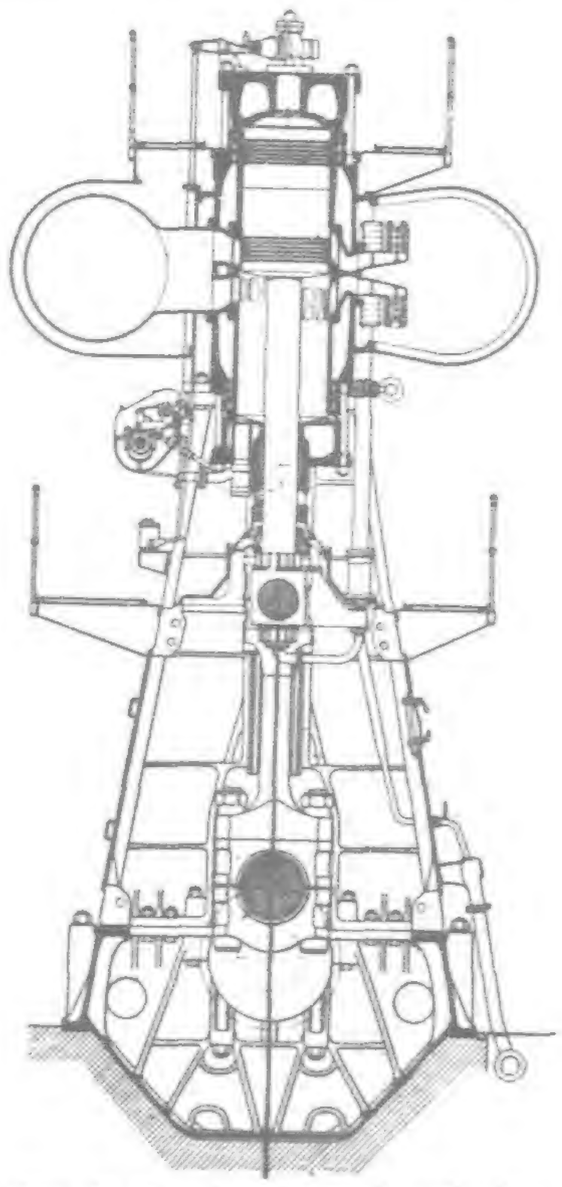


Fig. 5—Section through cylinder

Each upper and each lower combustion chamber has its particular fuel pump with eccentric drive and regulating mechanism (Figs. 12 and 13). The pumps are arranged in two sets of eight, for upper and lower cylinder ends respectively. Fuel is delivered to each valve during the early part of the compression stroke, and remains there until admitted. Quantitative regulation is effected by the governor through varying the stroke of the suction valve. Each pump can be put out of action individually with a small lever. The regulating, safety cut-out and control shafts each act independently on the suction valves. Priming is effected by means of a hand lever which can be applied to each pump.

The control station (Fig. 12) is remarkable for its simplicity, and so equipped that the engine can be put into service by one man in a very short time (1½-2 minutes) without risk of mistakes. As Fig. 4 also shows, it is at the front and of the engine on floor level. Immediately adjoining are the starting and injection air bottles, and the cooling water valves. Above is the load indicator showing the engine output; the revolution counter, and pressure gauges for air, water and oil. A small handwheel allows the delivery of the air compressors to be adjusted for special purposes, as for filling the air bottles after starting. By this means the automatic suction throttle

Fig. 4.—Elevation of 13,700 b.h.p. Double-acting, two-stroke Sulzer engine

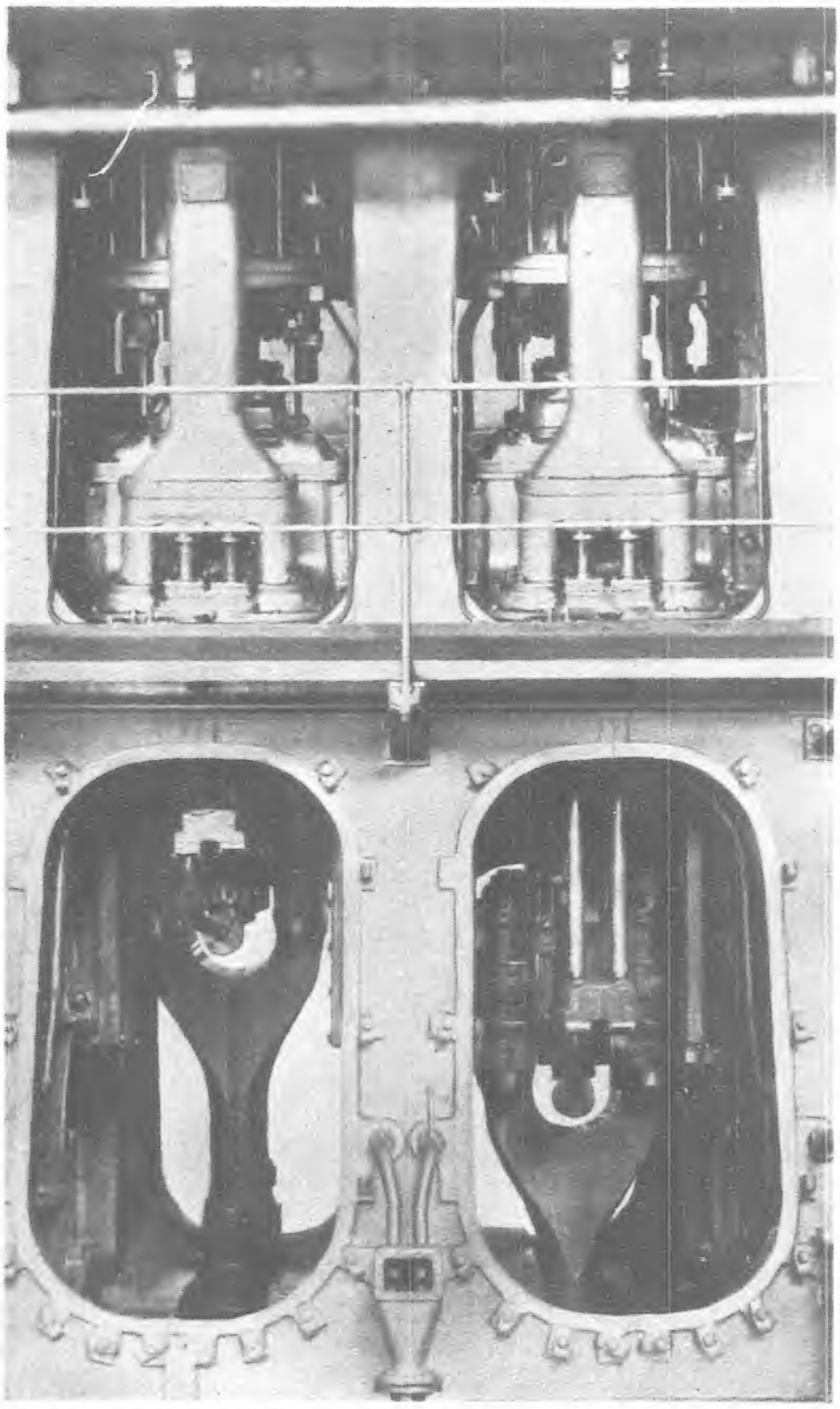


Fig. 6.—Bottom cylinder covers, reciprocating gear and crank case (with doors removed)

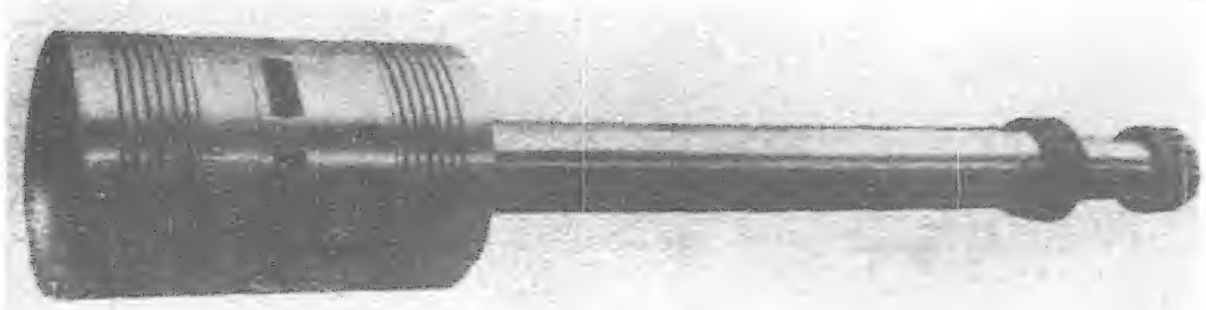


Fig. 8.—Piston and piston rod

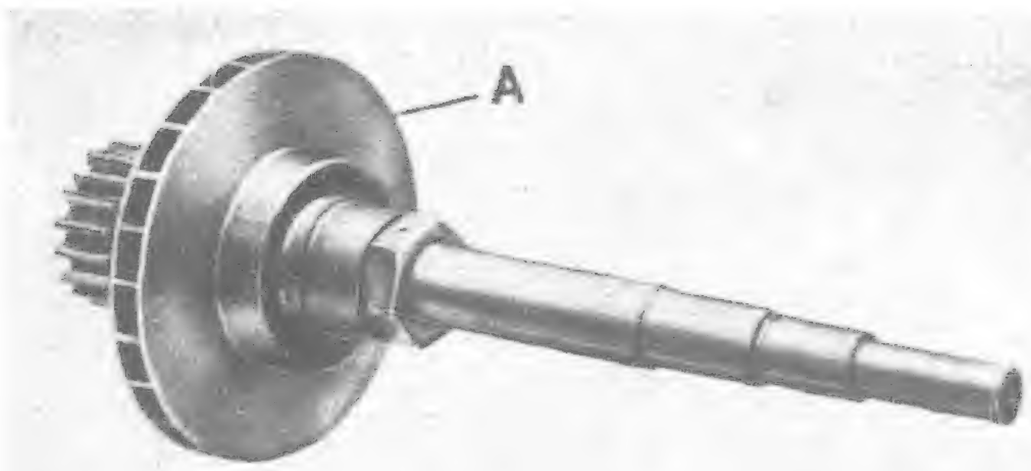


Fig. 16b.—Governor impeller

Fig. 7.—View along cylinder heads of the 13,700 b.h.p Sulzer engine

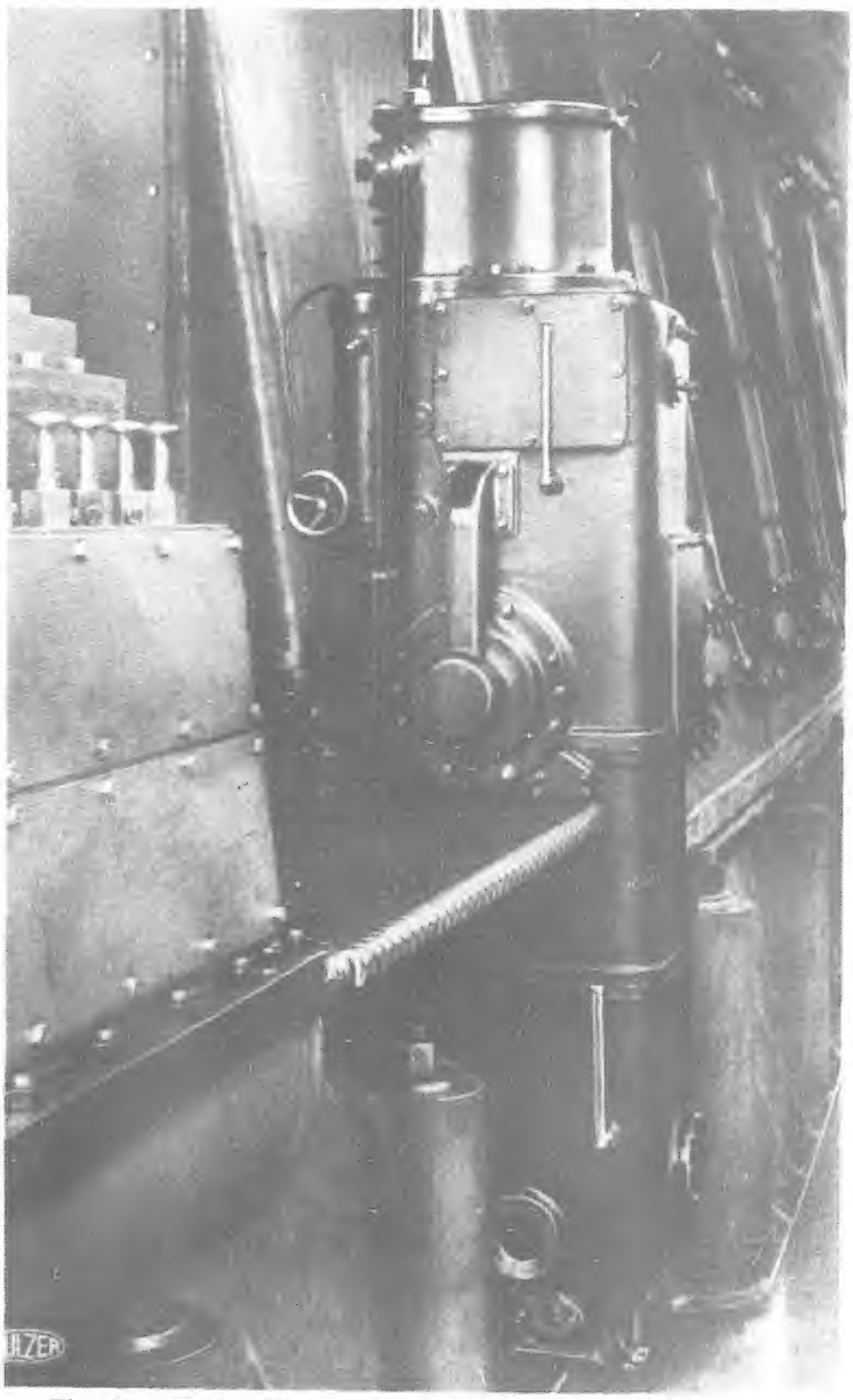


Fig. 17.—Hydraulic governor of 13,700 b.h p. Sulzer engine

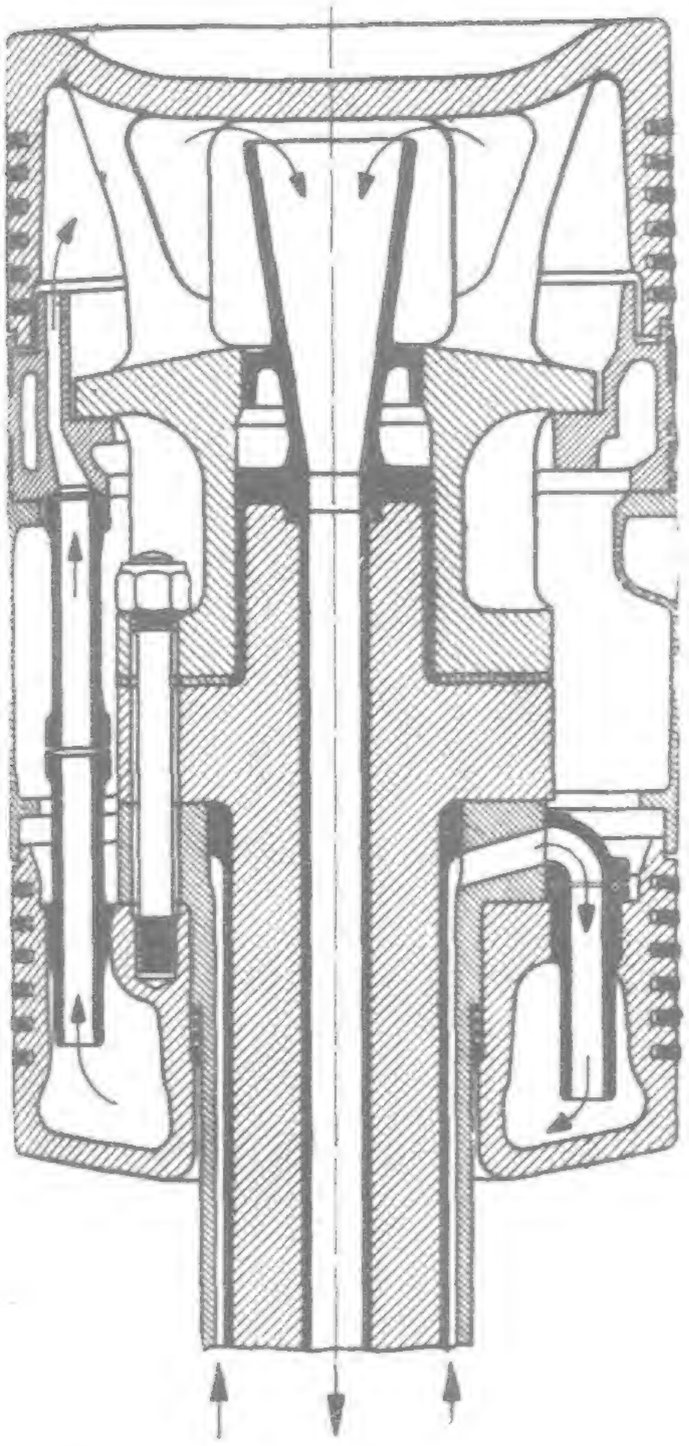


Fig. 9.—Section through piston

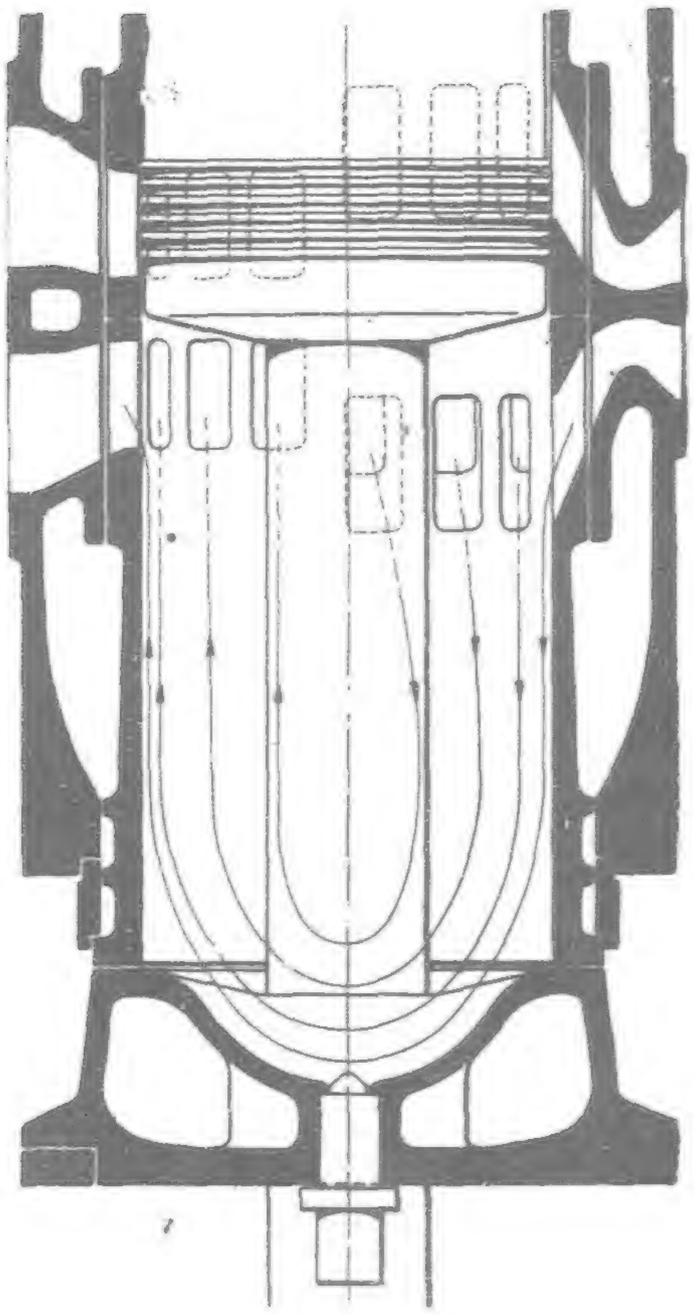
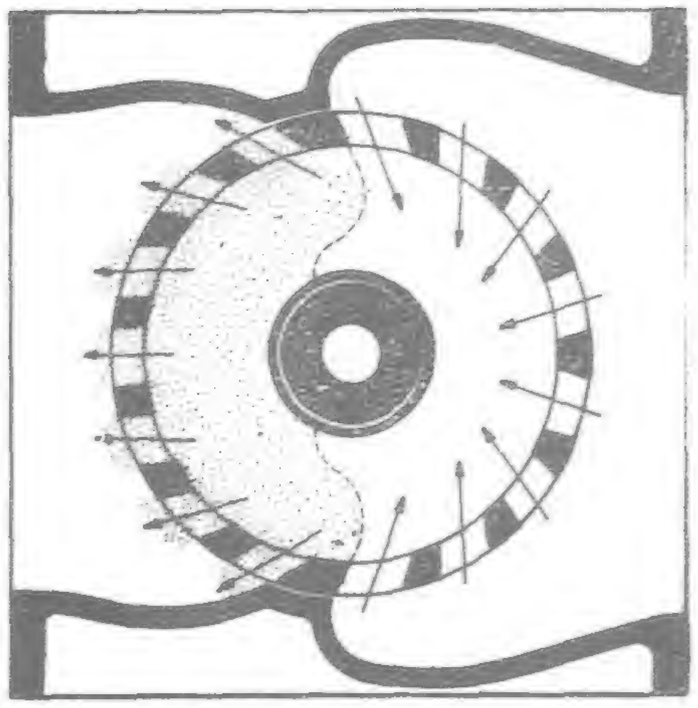


Fig. 10.—Diagram illustrating scavenging of lower combustion chamber



valve regulating mechanism, which is joined with the fuel regulating system, is modified. The two fuel pump sets are next to the control station. The drive is transmitted from the crankshaft by spur gearing. The hydraulic governor is mounted on the engine framework near the fuel pumps.

Method of Control

The engine is controlled by means of a handwheel, which can only be turned in one sense. An indicator shows the various positions. After one turn from the position of rest, starting air is admitted and the injection air stop valve opened. The engine revolves; a further turn causes fuel to be delivered to the upper cylinder ends, and these commence to fire. By further turning the handwheel, starting air is cut off and fuel successively delivered to the lower cylinder ends. Certain and smooth starting is thus achieved in practise, and was a feature of the trials. The normal starting air pressure is 30 atm. (425 lbs./sq. in.), but 15 atm. pressure is sufficient to start up. To stop the engine two further turns are given to the handwheel, whereby the fuel pumps are put out of action, injection air is cut off and the piping vented.

The control mechanism for injection air is diagrammatically shown in Fig. 14. In turning the control handwheel to start the engine, valve 1 descends and valve 2 then opens: the pressure over the stop valve in the admission pipe is thus released, and the valve opens. Air passes by way of non-return valves (to protect the piping) to the fuel valves, which are mechanically operated. The air quantity is automatically regulated, in conjunction with fuel needle lift and fuel quantity, by the hydraulic governor. When the engine is being shut down, valve 2 is closed and valve 1 opened, admitting pressure to the stop valve and thus causing it to close. At the same time valve 3 is raised to blow off air in the injection piping.

The hydraulic governor is of particular interest. The increasing power of Diesel units and the more general adoption of the double-acting principle, with consequent larger resistance to governing influence, call for more powerful action than is possible with mechanical means. Governing systems employing servo mechanism therefore become necessary. For the exacting conditions of parallel working, which the multi-cylinder double-acting engine with its small cyclic irregularity fully satisfies, a very high degree of sensitivilty and rapid operation are required of the governing organ. These demands are fulfilled by the hydraulic governor. It can, further, easily be adapted to varying service conditions, since it can be adjusted within wide limits. The arrangement, which is protected by letters patent, consists essentially of a pump, driven directly from the crankshaft, delivering oil at a pressure varying in accordance with the speed of the engine, and a servomotor acting on the regulating mechanism of the engine (i.e. the fuel pump, by-pass valves, the fuel needle lifting gear, the air compressor throttle).

A section through the governor is shown (Fig. 15) and photographs of the working parts (Figs. 16a, b). The method of operation is as follows:—

The pump rotor A delivers oil under pressure below the control valve B, at a. The upward force is counteracted by the spring K and the oil pressure on the surface b. The sliding control valve therefore tends to take up a position of equilibrium.

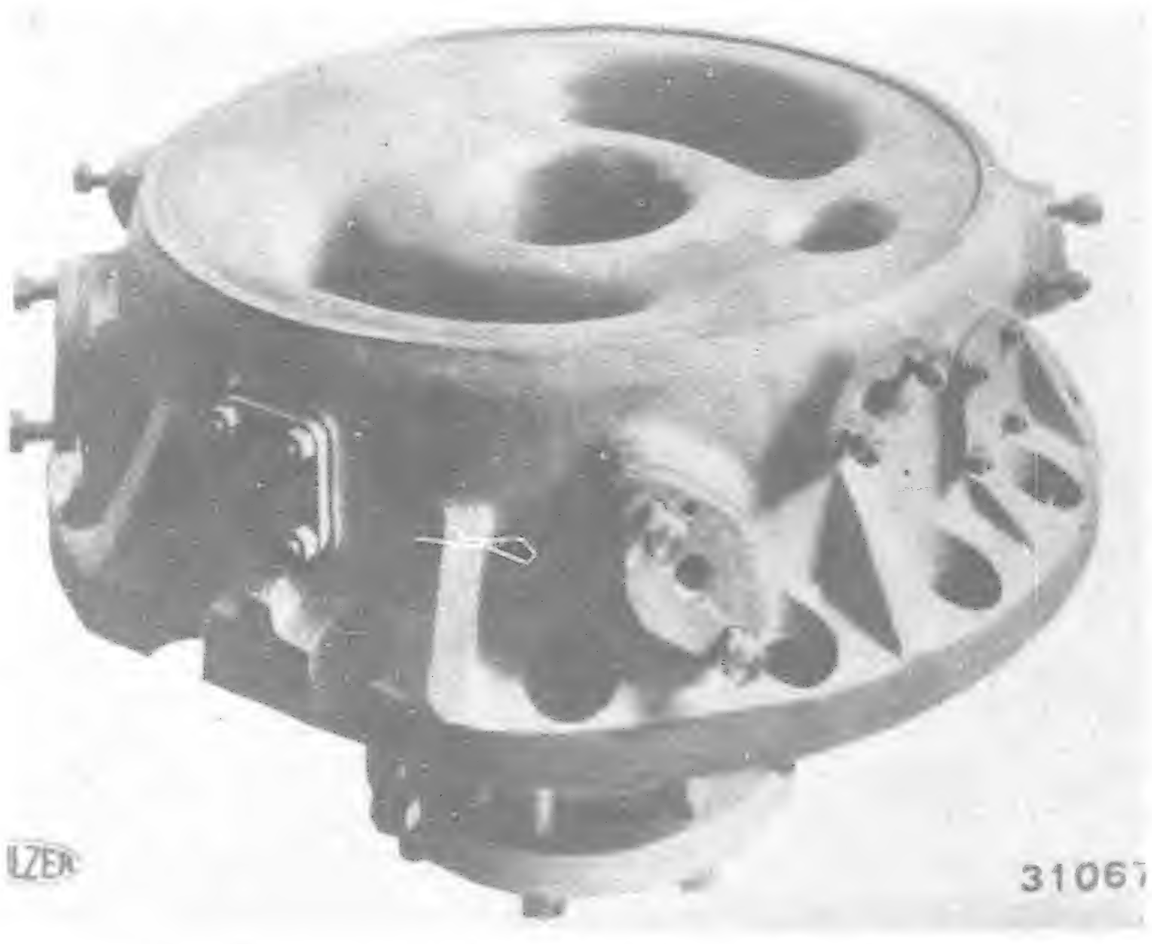


Fig. 11.—Bottom cylinder cover showing combustion pockets

The edges c and d control the flow of oil to and from the surface e of the servo piston C, increasing the pressure under the servo piston when the control valve descends, and vice versa. When the control valve B is in its middle (neutral) position, the oil under the servo piston at e is enclosed, and the piston remains in the position taken up until the control valve B is moved by a fresh governing impulse. Equilibrium of the servo piston is maintained by its weight and by a constant oil pressure acting on the surface f. The dimensions are ample to enable all reactions to governing influence to be overcome under any circumstances.

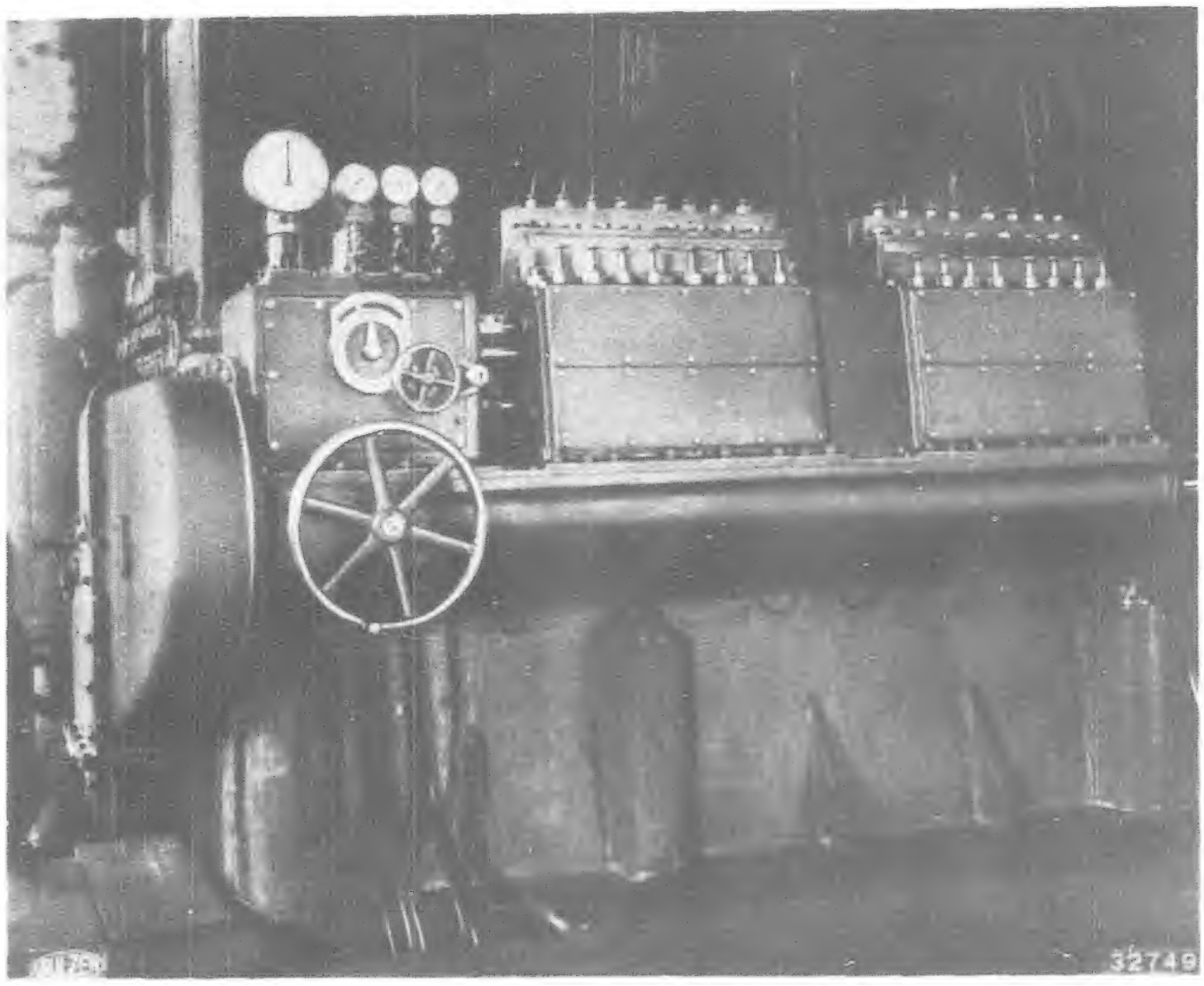


Fig. 12.—Control Station

When for example the effect of reducing the engine load is considered, the governing action commences with an increase of the oil pressure delivered by the pump rotor as a result of the greater crankshaft speed. The increase of pressure causes the control valve to rise, releasing oil from under the servo piston e, which falls. The fuel quantity injected into the cylinders is thus reduced until corresponding to the new load on the engine : for in falling the servo piston increases the tension of the control valve spring K, through the medium of the lever D pivoted at E. Thus a new state of equilibrium is attained with the control valve again in its neutral position.

Assisting this mechanical return motion of continuous character, is an hydraulic stabilising action which has a damping effect when the throw is large. In the governing operation just described, oil is displaced by the surface g of the falling servo piston to exert pressure on the flange b of the control valve, the two chambers being joined together and with the speed adjusting device. The effect is to move the control valve back to its neutral position, the pressure in the hydraulic return motion system being determined by the spring tension of the speed adjusting device. Increased tension of the spring, adjustable by means of a handwheel or remote control, raises the oil pressure in the system and causes the servo piston to rise. The engine speed becomes greater accordingly, with a corresponding increase of the pressure delivered by the oil impeller restoring equilibrium through the control valve. Similiarly, reduced tension of the spring causes the engine speed to fall off.

The control piston valve B moves in a bush, with suitable ports, which is mechanically vibrated through some tenths of

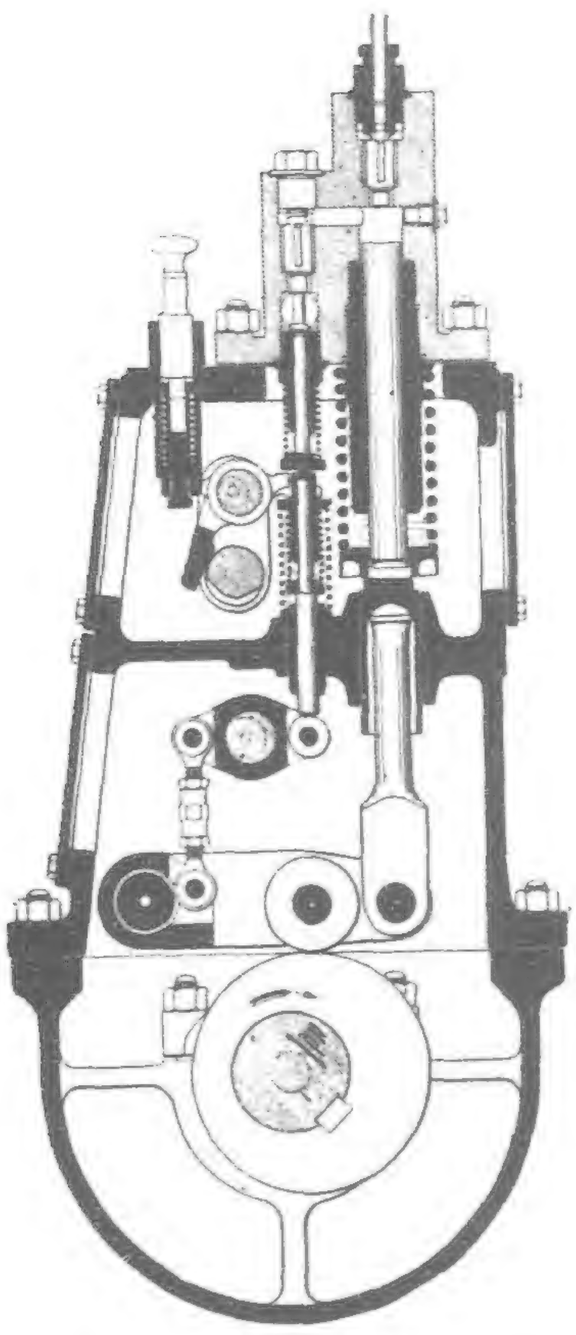


Fig. 13.—Section through fuel pump

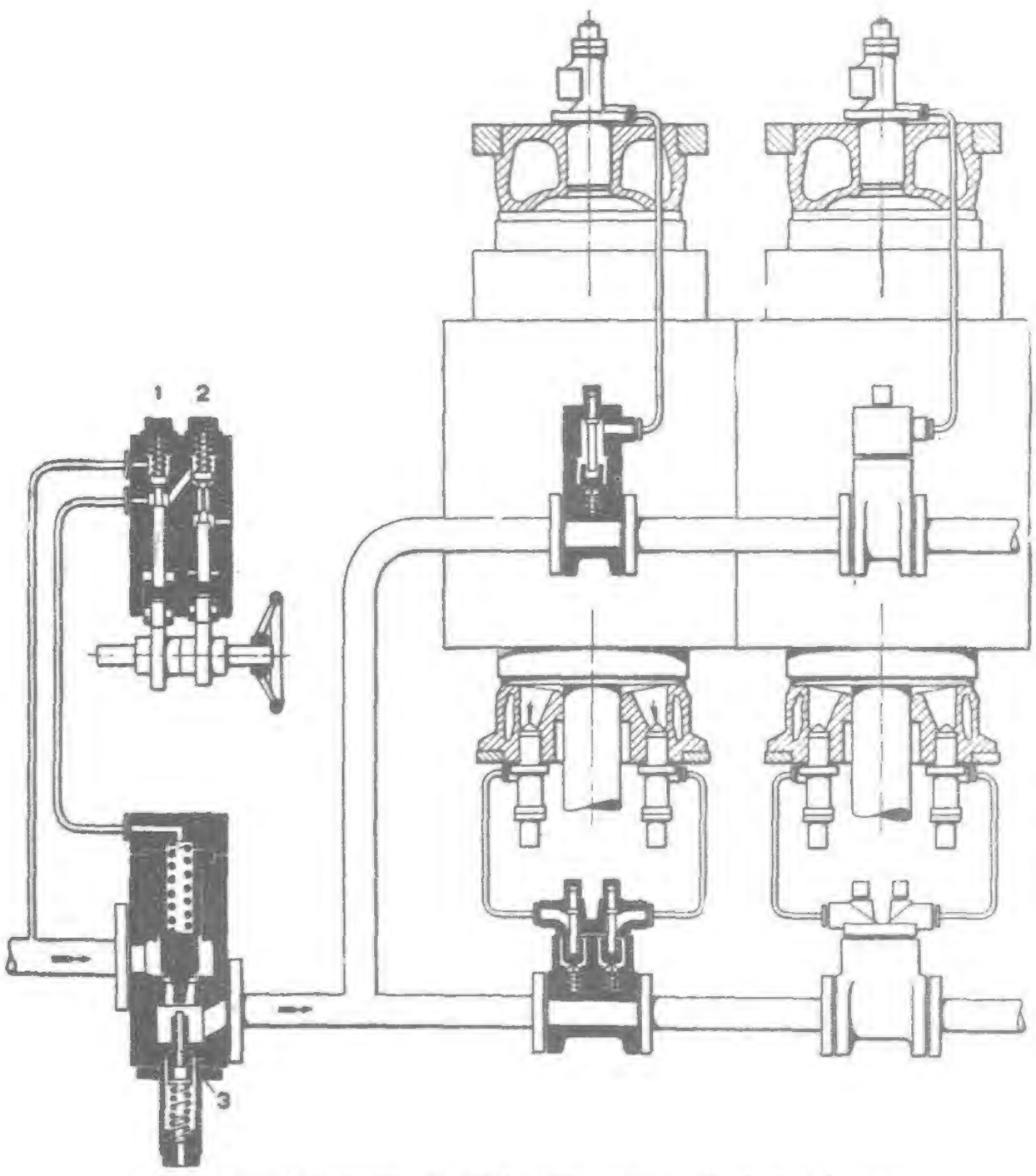


Fig. 14.—Diagram of injection air control mechanism

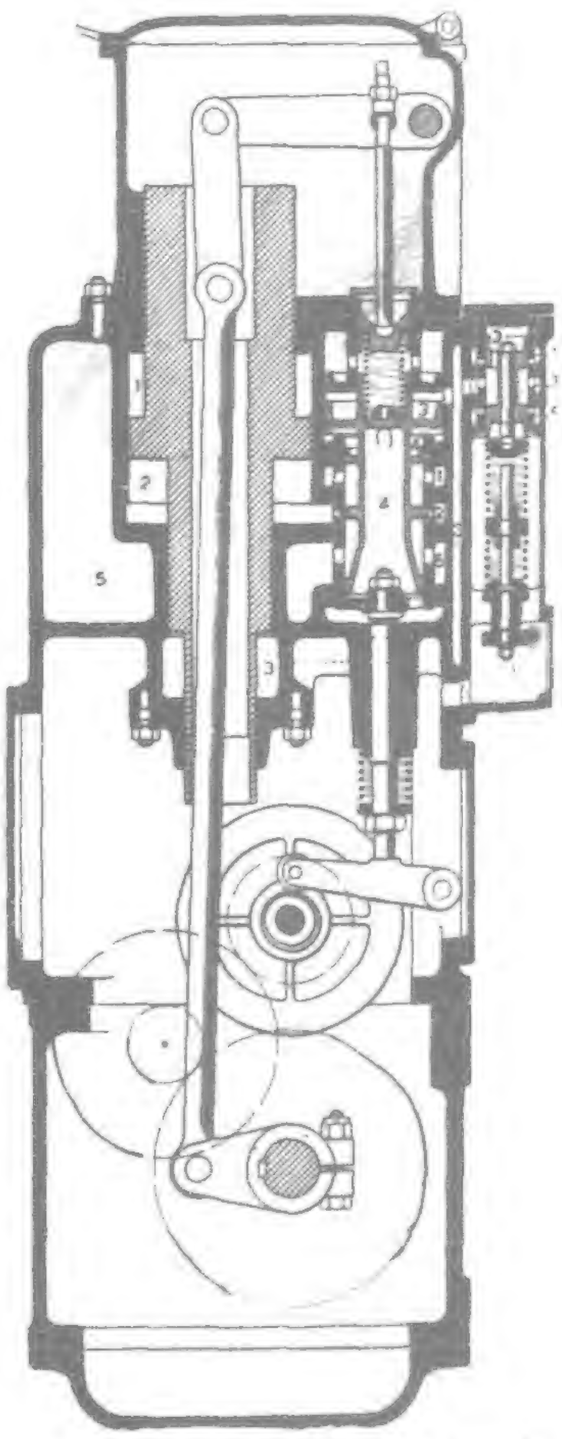


Fig. 15.—Section through hydraulic governor

(1) Pressure oil circuit.
(2) Servo power chamber.
(3) Hydraulic return motion circuit.
(4) Governor impeller circuit.
(5) Oil return.

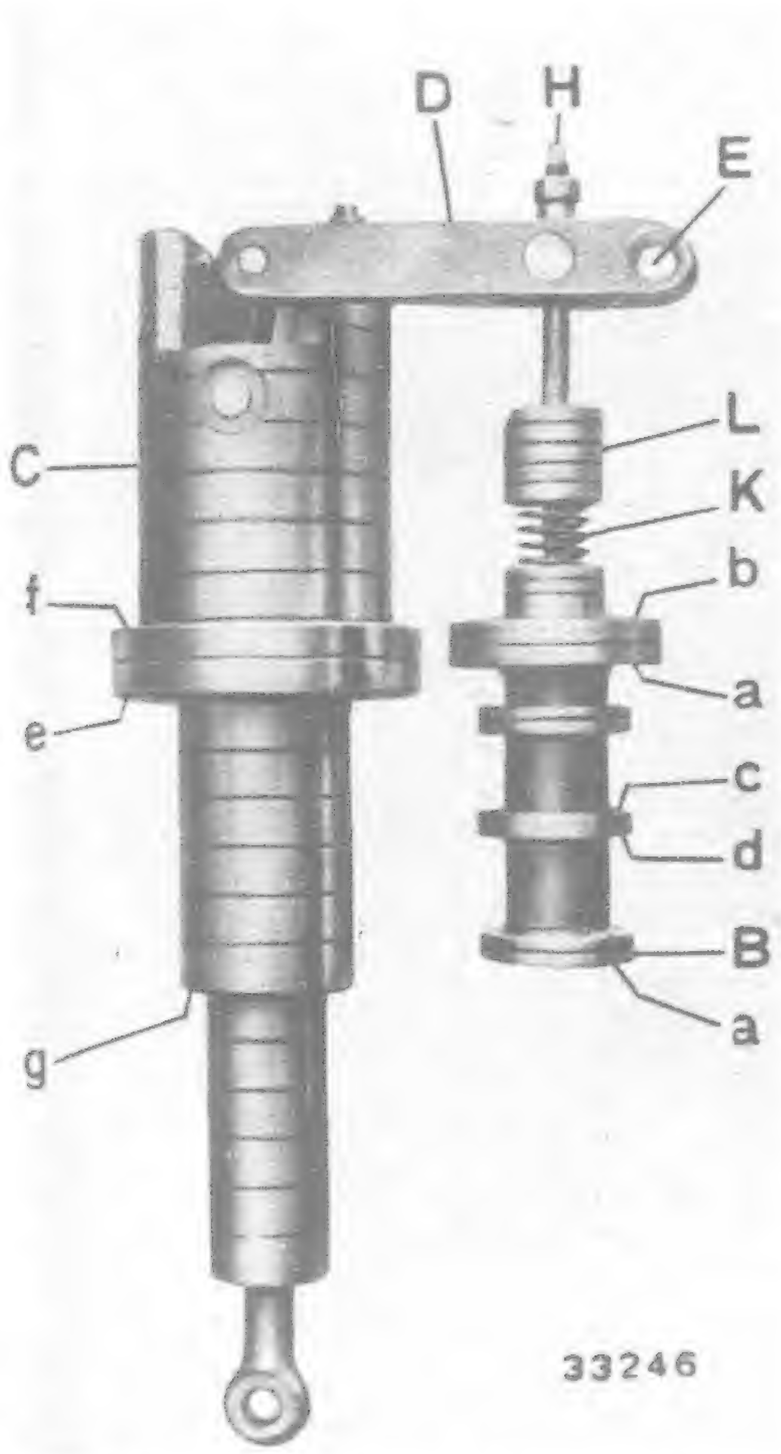


Fig. 16a.—Servo piston and control valve piston of governor

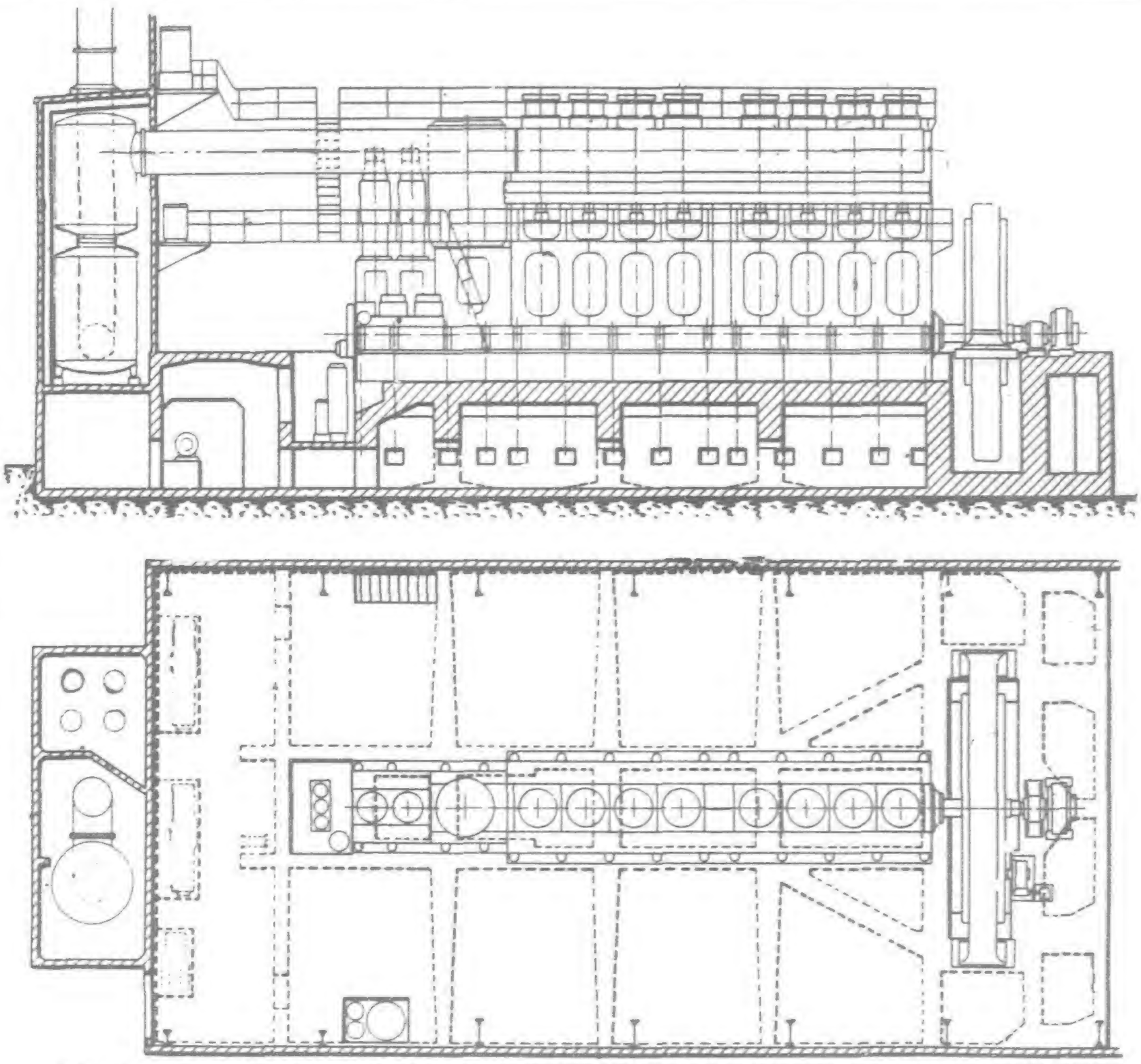


Fig. 18.—General plan and elevation of 13,700 b.h.p. Sulzer diesel generating plant

a millimetre. This constant pulsation is transmitted through the oil to all governing members, largely eliminating frictional resistances and thus effecting a high degree of sensitivity. Since forces are directly transmitted by fluid pressure, no loss of accuracy can occur through joint backlash.

Foundations and Auxiliaries.—The engine is installed along the length of the engine building, room being provided for a similar engine in the same axis (Fig. 18). The end-to-end arrangement, with alternators in the middle, results in a symmetrical static loading of the foundation and makes possible a considerable reduction of the free dynamic forces due to torque reactions. The internal stresses are low on account of the high degree of balance and the rigid framework of the engine. The foundations are of reinforced concrete and spread over a large area so as to reduce the specific loading of the subsoil.

The electrical switch gear is located in a separate building.

Exhaust Arrangements.—The exhaust pipe leads horizontally from the manifold to two large wrought-iron silencers, situated one over the other outside the building (Fig. 18). Thence a pipe is conducted upwards to above roof level. The 16 exhaust discharges per revolution of the engine constitute an almost regular flow, sudden discharges being obviated by the design of the ports.

Scavenging Air Intake.—The scavenging pump draws in air through two receivers arranged in series, baffles being incorporated for silence.

Cooling Arrangements.—Fresh water only is used for cooling, a liberal circulation being possible (1,320 gals./min. for cylinders and compressors, 710 gals./min. for pistons) with regard to the high summer temperatures experienced. In order to keep down the water consumption, a cooling-tower is utilized. The two circulating pumps, for cylinders and pistons respectively, are driven by a single electric motor. The pump set is duplicated, one set serving as stand-by.

Oil Purifying Equipment.—The lubricating oil is led from the engine sump to a triple filter, the filtering elements of which can be removed and cleaned while running; thence to the gear wheel pump and through the oil cooler back to the engine. There is in addition a special Laval centrifugal oil purifying plant, through which the sump oil is passed at regular intervals.

One of the advantages of the double-acting engine is the absence of oil contamination through residual products of combustion, since stuffing-box and oil scraper separate the combustion chamber from the crankcase.

Fuel Storage and Supply.—The engine can be run on lighter or heavy oils. There are two fuel storage systems, that for heavy oil being provided with heating contrivances. The change-over from one fuel to another can be effected from the control station of the engine. Fuel is pumped from the storage tanks outside to the reservoir in the engine building, from where it flows under gravity by way of filter vessels with floats to the fuel pumps.

Urals Oil Field Ready

Two oil gushers in the Chusov oil fields in the Urals are yielding from 400 to 500 tons of oil per day, according to a report from Sverdlovsk. In this connection the Eastern Oil Trust states that the Ural fields are suitable for industrial expolitation.

Since the discovery of oil in Bashkiria last spring, explorations have been in progress and an area of 15 square kilometers, with a layer of oil yielding soil 150 to 250 meters deep, has been tapped. The area is estimated to contain about 75 million tons of oil with about 30 per cent of gasoline. The structure of the soil in these fields was such that ordinary methods of drilling could not be used and new methods were devised. The report declares that extensive explorations are being made in the valleys along the Volga. Indications of oil have already been noted in a number of new districts. The Eastern Oil Trust has undertaken to produce 75,000 tons of oil in the new oil fields of the Urals, Bashkiria, Middle Volga and other regions this year.

Philippines Productive Gold Mines*

Their Number Grows, Prospecting and Filing of Claims Speeds at Gold Rush Pace—but—

THE data in the table accompanying this comment cover 10 months' gold bullion exports from the Philippines to the United States in 1932 and 1933 respectively, January to October inclusive. They indicate that this year's output of gold in the Philippines is not exceeding last year's, and are therefore somewhat surprising even in editorial offices; but they are official customs house data, compiled reports of all shipments. The statue value of gold is taken, $20.67 an ounce, and the bullion value based on this is determined from the assays. If you cipher the data for this year, you will find that the average value per ounce of gold bullion exported from the islands is P.22.73; it is about half the statute or standard value of refined gold, and the bullion is refined in the United States, never in the Philippines.

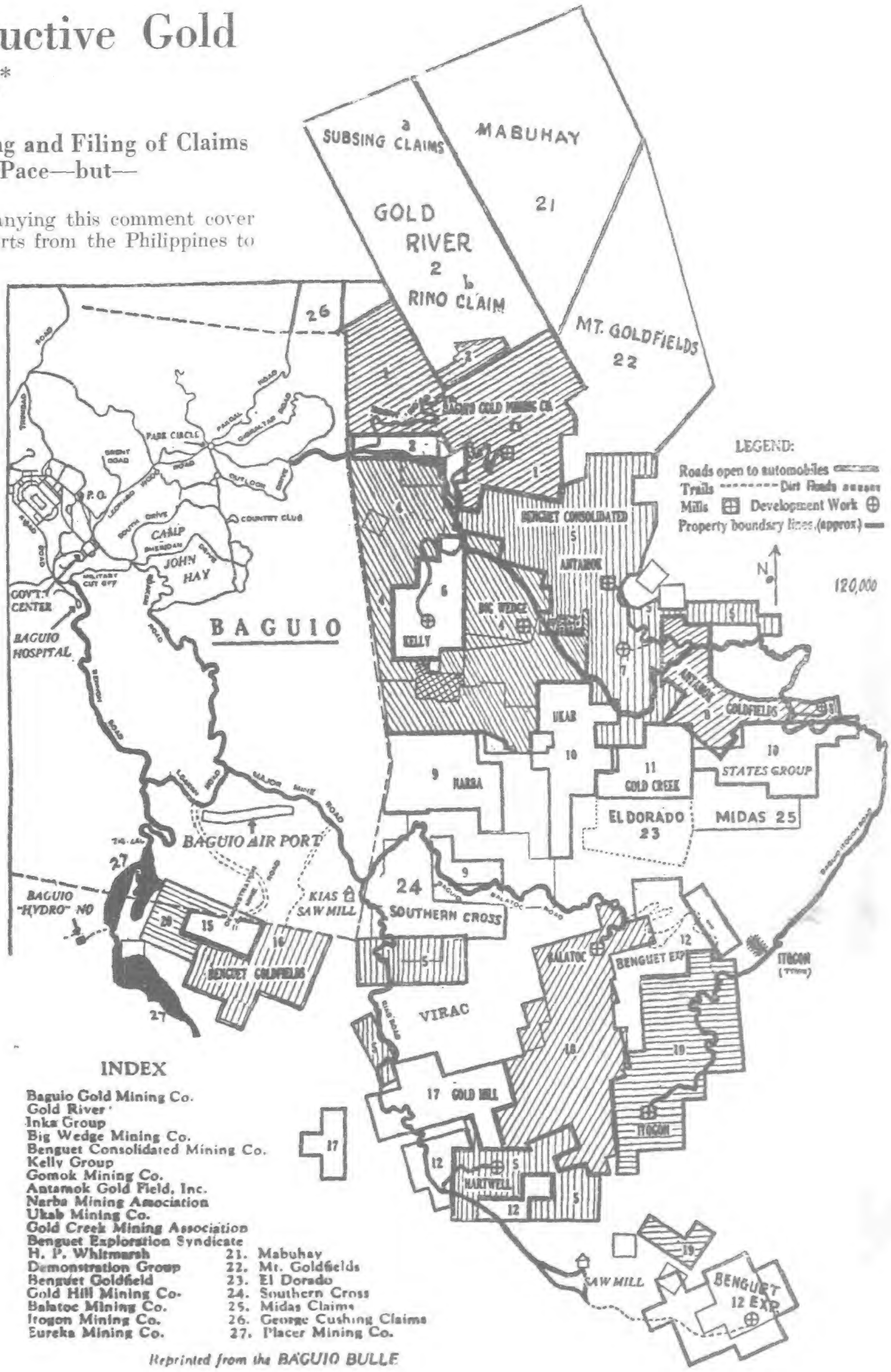
Philippine gold bullion as prepared for export to the United States runs quite consistent values: P.23.44 an ounce in July, P.22.82 in August, P.22.94 in September, P.22.07 in October. But though this year's output is not exceeding last year's (up to the end of October), the bulk of the output has been sold since that day late in October when President Roosevelt authorized purchase of new gold at or above the world price, so this year's returns in dollars will run far above last year's perhaps 35 per cent or 40 per cent above. The bulk of the bullion continues to come from the twin bonanza properties, Benguet Consolidated and Balatoc. Up to the end of October, Benguet Consolidated had shipped 163,077.80 ounces of gold bullion to the United States, valued at P.3,889,770.78; and Balatoc had shipped 187,904.85 ounces, valued at P.4,180,311.12; so the total of 10 months' shipments from the two mines was 350,981.65 ounces, valued at P.8,070,081.90.

Judge John W. Haussermann, president of the two companies, kindly furnishes the Benguet-Balatoc figures. If all shipments up to the end of October had been reported and included in the customs report for that month, this would leave only 2,824 ounces of gold bullion as the combined output during 10 months of all other mines in the islands. But as not only Benguet-Balatoc's output of bullion has increased this year, but that of other mines too, it is assumed that shipments were made in October that will only be taken up in later customs reports. Mining men are one in saying our output of gold is increasing, and the year's complete figures may well verify their opinion.

Nevertheless, the situation even as finally verified does show there has been much more smoke than fire in all the gold furor. This journal believes, and has therefore said, that many successful gold mines will eventually be developed in the Philippines. But the way to this, when you compare outputs with the stock market, surely involves many a hard experience. Here are the mines that have mills, and the capacity of the mills in tons of ore daily:

Benguet Consolidated, now running 550 tons a day, expects to run 600 tons a day by January 15. Balatoc, now running 450 tons a day, expects to be running 600 tons a day by the end of February, 900 tons a day by the end of April. Itogon, 200 tons a day. Baguio Gold, 150 tons a day. Antamok, 200 tons a day. Benguet Exploration, 50 tons a day. Big Wedge, 30 tons a day. Paniqui Mines (at Araroy, Masbate), 300 tons a day. Southern

(Continued on page 134)



Reprinted from the BAGUIO BULLE

The American Chamber of Commerce Journal

New Hydro-Electric Development for Imperial Japanese Government Railways

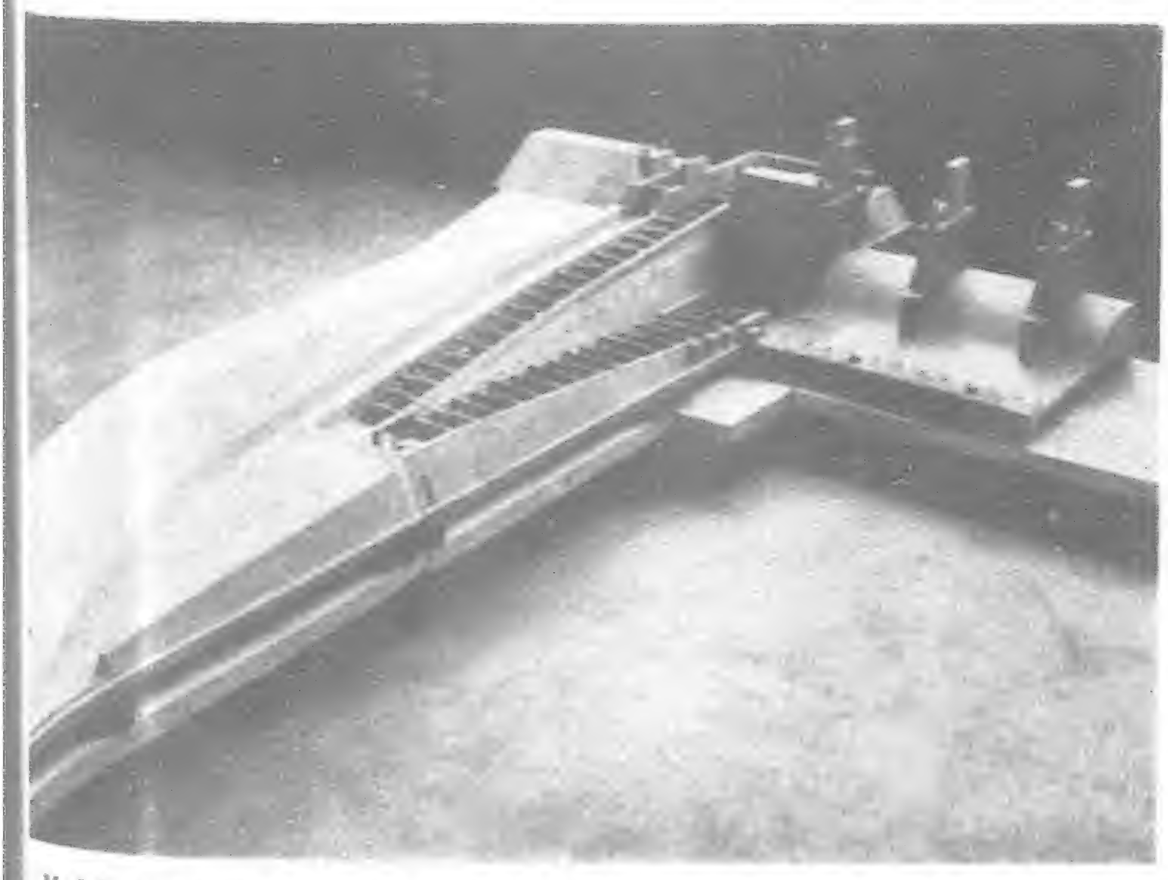
By W. HARVEY CLARKE, JR.

In the fastnesses of the Joetsu highlands, Central Japan, the course of the Shinano River is fed by perennial snows that cling to the topmost peaks of what are popularly called the Japanese Alps. There in Niigata Prefecture, near the town of Tohkamachi, an extensive hydro-electric project is under way to generate power needed to continue electrifying the Imperial Government Railways, which have for some years past been in process of undergoing the change from steam locomotion.

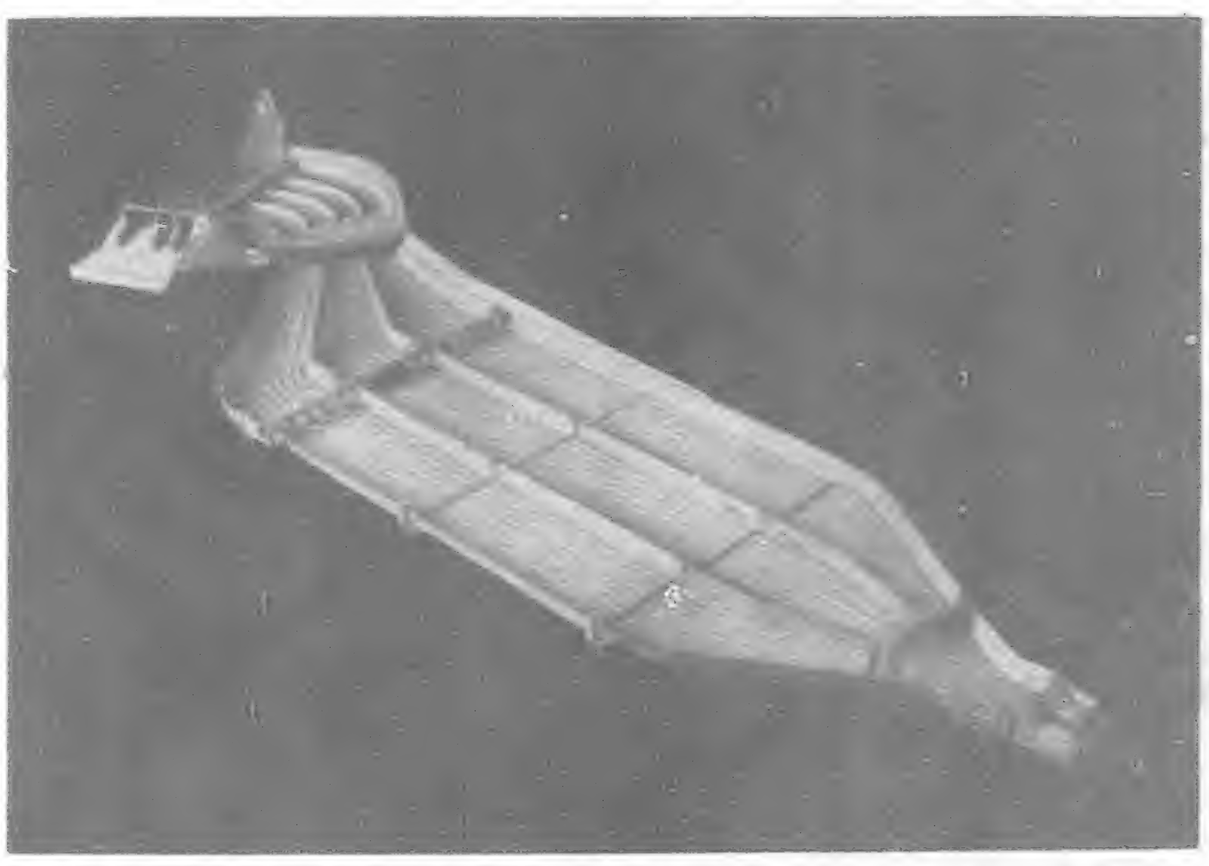
Drawing water from the main stream of the Shinano at the village of Kaino, power will be initially developed at the village of Senju and then at the village of Yamabe, exhaust from both stations being discharged into the river. The power's source, a water tunnel system to be built in two stages, will consist of two parallel waterways capable of producing a total of 168,000 kw. of electricity. A number of interesting features, including a dam, an inlet, a sand pond, a regulating pond, a power station at Senju and a waterway, go to comprise the first of four project-units or stages, which is designed, when completed, to generate approximately 44,000 kw. of electric power.

With another waterway leading to Senju station, the second unit will nearly double the capacity of the first. Thus, eventually, about 84,000 kw. will be available from the combined first and second units.

View looking down stream along the Shinano River where construction of an intake dam with five spillway gates and a non-overflow dam is in progress, November 1933



Model of the intake dam with loftway and fish ladder between non-overflow dam and spillways, which have dentated sills in front



Miniature of sand pond with the inlet adjacent to the spillways showing three parts divided lengthwise and four sections crosswise, each being provided with a scouring sluice gate

It is planned, then, to construct each half of the Yamabe power station and its waterway as the third and fourth units of the project. Appropriations for the first and second units having been passed by the Japanese Diet, work on the first was begun in April, 1931. The date of completion is set for sometime in March, 1939, for the first unit and three years later in March. 1942, for the second unit.

CONSTRUCTION COSTS.—The total cost of construction is expected to reach Y.15,271,400, including waterways, power stations, transmission line and receiving stations, itemized for the first and second units as follows :

	1st Unit	*2nd Unit*	*Total*
Waterway	Y. 7,070,490	Y.3,749,410	Y.10,819,900
Electrical Construction ..	1,049,510	745,590	1,795,100
Transmission Line	2,021,300	—	2,021,300
Receiving Station	469,800	165,300	635,100
Total	Y.10,611,100	Y.4,660,300	Y.15,271,400

Plans and designs for the undertaking were drafted by Mr. H. Noguchi, an engineer on the non-official staff of the Government Railways. Between 1931 and 1933, Mr. S. Horigoshi was chief of the Shinano River Electric Office. Mr. S. Nagaya in April, 1933, succeeded him as chief construction engineer.

Descriptive Points—First and Second Units

Intake	Shinano River.
Site of Intake	*Miyanaka, Kaino Village, Nakaunuma* District, Niigata Prefecture.
Site of Power Station	Kamiarai, Senju Village, Nakaunuma District.
Site of Outlet	Okitate, Senju.
Catchment Area at Site of Inlet	7,989 square kilometers.
Volume of Water Intake ..	After completion of 1st Unit 83.48
(In cubic m./sec.)	,, ,, .. 2nd .. 166.96
Available Water Volume ..	,, ,, .. 1st ,, (max.) 104.34
(In cubic m./sec.)	,, ,, .. 2nd ,, .. 194.78
Effective Head	,, ,, .. 1st ,, .. 51.147
(In meters)	,, ,, .. 2nd ,, .. 51.701
Power Generated at Senju Station	,, ,, .. 1st ,, .. 44,277
(In kilowatts)	,, ,, .. 2nd .. ,, 83,541

Salient features of the first and second units are given below :

On the left side of the Shinano River facing upstream, the spillway, which is a part of the 330 meter intake dam, is 180 meters long. With its top at normal river level, the spillway has an average height of 7.27 meters above bedrock, with nine "Stoney Type" gates 15.15 meters across and 7.58 meters high, besides two scouring sluice gates 7.58 meters in width and height. In the event of a flood flow, the level of the water may be lowered considerably if all these gates are opened. On the spillway's right side will be a gravity-type concrete non-overflow dam sloping on its downstream surface and having a maximum height of 15.8 meters above bed-rock.

The fish ladder and loft and raftway will be at the spillway's point of contact with the non-overflow dam. The former, an overflow type, measures 10.91 to 7.27 meters wide with a 1/15 slope, while the latter has a 4.54 meter width and a 1/15 slope. In addition to protecting the river bed from being scoured, dentated sills will serve as a conducting weir for the fishway on the downstream surface of the spillway.

The intake is on the left (upstream) side of the dam. It consists of eight watergates, each 6.06 meters across, with screens in front. Then there are the partition wall and the draw weir with scouring sluice gates between them. Through these gates water can reach the intake beyond the weir, thereby making it easier to exhaust the soil between the intake and the partition wall when they are opened.

Near the intake is the sand pond, which in pattern resembles a honeycomb. It measures 353 meters long, 121 meters wide and 5.3 meters in mean depth. Soil is deposited by reducing the velocity of flow in the pond to 0.27 m./sec. The pond area, having about a 1/50 slope, is divided into three parts lengthwise ; its bottom into four sections crosswise. Soil can be exhausted from the pond by draining any given section through the scouring sluice gates and sand flushing sluice located at one end of the pond.

WATERWAYS.—By means of two waterways, each 7.6 kilometers long, tunneled along most of their course, but including a 468 meter culvert connecting with the sand pond, water from the pond will be conveyed to the Asagawara regulating pond. Both of them, formed like a horseshoe, will have a 6.82 meter span and height with a 1/2000 slope, one having a concrete and the other a reinforced concrete lining.

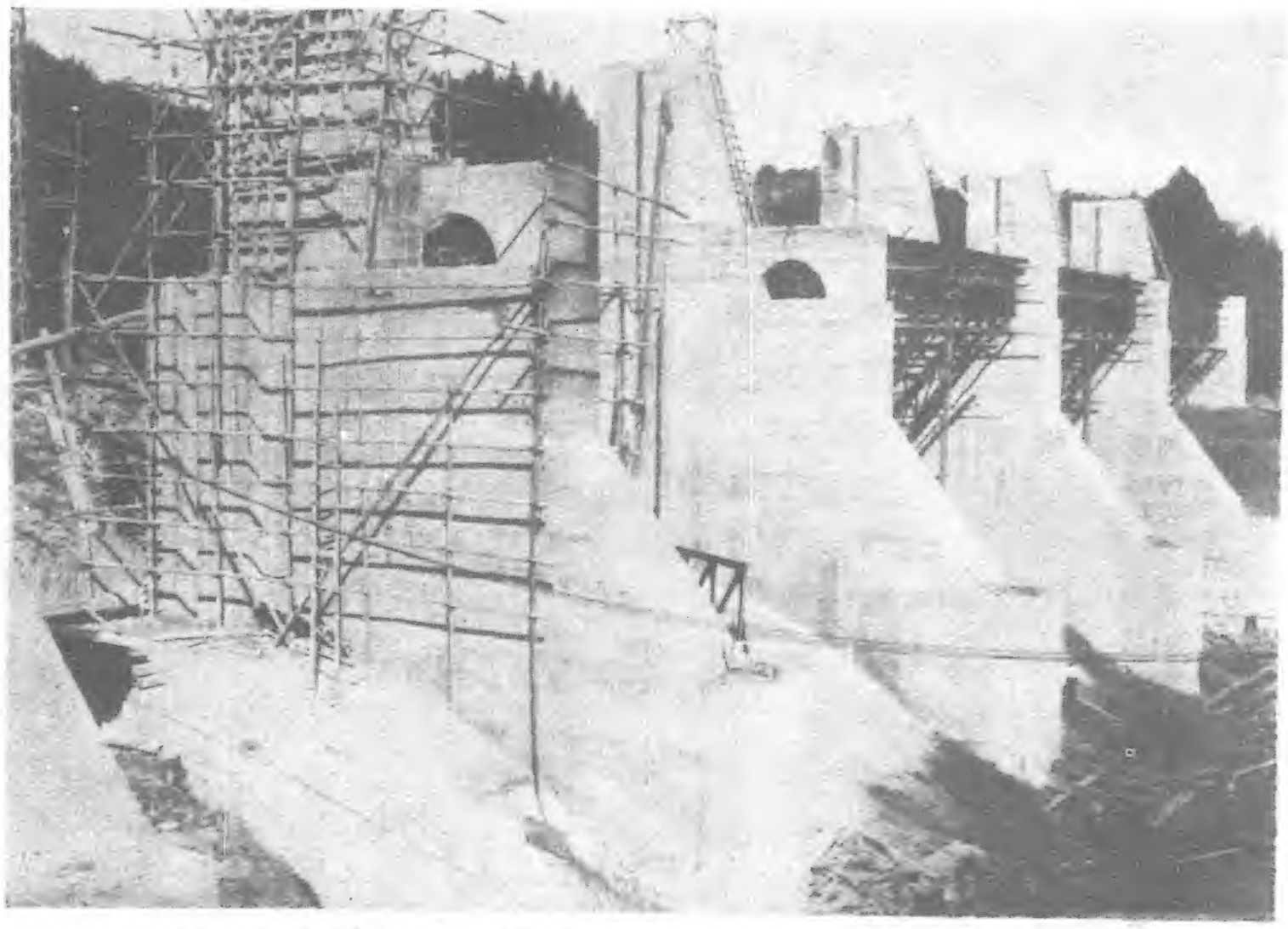
REGULATING POND.—Across the Asagawara River valley is being built an earth dam having a maximum height of 39.4 meters, a top length of 216 meters, an impounding area of 132,000 square meters, an available water depth of 9.1 meters and an effective storage of 1,425,000 cubic meters of water. The surface slope of this dam will be 1/3 on the upstream and 1/2.5 on the downstream side of the river. The dam is to have a clay core wall under which a concrete cut-off trench reaches to impervious sub-surface strata. In the regulating pond a reservoir will be installed to connect the water tunnel with the one for pressure. In case of a small load, water in service reaches the powerhouse by passing through two pressure tunnels, and excess water overflows into the regulating pond. But in the event of a peak load, water in the connecting reservoir will be conducted directly to the powerhouse through one pressure tunnel, while the excess overflowing into the regulating pond and mixing with the water there will be conveyed to the power plant through the other. Thus a loss of head due to operation of the regulating pond can be minimized.

PRESSURE TUNNEL.—Beginning at the connecting reservoir and passing beneath the pond as well as both the villages of Yoshida and Senju, the pressure tunnel extends on to the surge tank. It is three kilometers long, 6.7 meters in diameter, has a 3.50/00 slope and a reinforced concrete lining.

WATER TANK.—A cylindrical differential surge tank will be provided for one line of the tunnel, serving not to cause water to overflow when the total load of the plant drops to zero. It will have a 30 meter diameter, a 32 meter height and a riser of six meters. Built of reinforced concrete, about two-thirds of its height will be underground.

PIPELINES.—Under the surge tank, the pressure tunnel will be divided into three pipelines, each 4.5 meters in diameter, the upper end buried in the ground and the lower end on its way to the power station skirting the slope of a mountainside.

TAILRACE.—Discharging water from Senju station to the Shinano River, the tailrace is a trapezoidal shaped canal employed in the first and second units. It will have upper and lower widths of 30.9 and 15 meters respectively, a depth of 5.3 meters, a slope of 1/3000, a length of two kilometers, and its bottom and sides will have a thin lining of ferro-concrete. Close to the outlet a diversion will be constructed to join the waterway of the third and fourth units.



The right or upstream side of spillways nearing completion, November 8, 1933

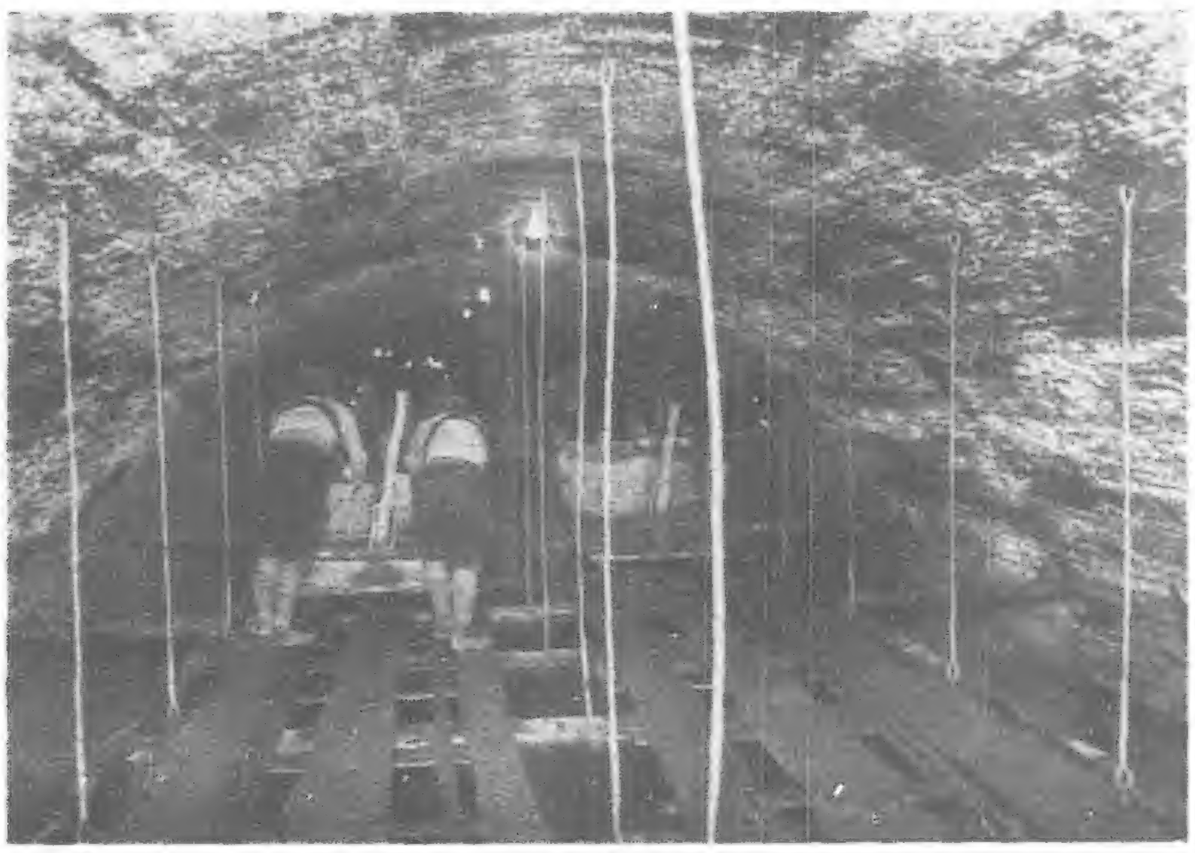
Power Station and Transmission Line.—A vertical turbine and generator will be installed in the power plant. Power generated will be transmitted to Tokyo, being stepped up by an outdoor transformer on the side of the power house. The transmission line will extend to the village of Musashi-Sakae, county of Tokyo, beyond the boundary of the Joetsu region. It will be some 200 kilometers long, negotiating the most hazardous pass in a mountainous region. At Musashi-Sakae there will be built a receiving station where power is stepped down to 66,000-volts to be available for tram lines and the operation of electric trains in the vicinity of Tokyo through the 66,000-volt transmission network already established, together with power from the Government plants at Akabane and Kawasaki, suburbs of the Capital.

Views of completed non-overflow dam and spillways which are being concreted: At left, as seen from left bank of Shinano River looking upstream; At right, looking downstream from right bank, November 7, 1933

Reinforcing the sand flushing conduit. A concomitant part of the sand pond

Water tunnel heading being excavated

Interior views of water tunnel being built: Left, concrete transport trackways suspended at top of shaft, April 22, 1932; Right, mucking trucks drawn by small electric traction engine, February 15, 1933



Suspended in upper tunnel section, scaffolding along which runs trackway to transport concrete from mixing plant through vertical shaft to spot where it is poured

Showing section of water tunnel at junction of two horizontal shafts

Descriptive Points—Third and Fourth Units

Site of Intake	Tomoshige, Senju Village, Nakaunuma District, Niigata Prefecture (Tailrace of Senju Station).		
Site of Power Station	Yamamoto, Yamabe Village, Kitaunuma District, Niigata Prefecture.		
Site of Outlet	(ditto)		
Available Water Volume ..	After completion of 3rd Unit (max.)		104.34
(In cubic m./sec.)	,, ,, ,, 4th ,, ,,		194.78
Effective Head	,, ,, ,, 3rd ,, ,,		51.573
(In meters)	,, ,, ,, 4th ,, ,,		51.68
Power Generated at Yamabe	,, ,, ,, 3rd ,, ,,		44,646
Station (In kilowatts)	,, ,, ,, 4th ,, ,,		83,520
Total Power Generated at Senju and Yamabe Stations (In kw.)	,, ,, ,, 4th ,, ,,		167,061

When construction work on the third and fourth units will begin is still undecided; but the project involves two water tunnels starting at the diversion canal of the tailrace at Senju and extending to the villages of Yamamoto and Yamabe. Water power will be developed by means of a surge tank which, in addition, will serve as a regulating pond.

Progress of Construction

Preliminary work was begun in April, 1931, and actual construction commenced less than four months later.

(*a*) PRELIMINARY WORK.—Preparatory construction included buildings, laying of railroads for transport service, cableways and installation of electric power and communications. Offices, stations, storehouses and official residences were rebuilt from remains of the old Shinano River Electric Company's equipment (used between 1921 and 1924) by repairing and removing.

RAILROAD CONSTRUCTION.—A total of 3,320 meters of railway has been laid from the Government line at Tohkamachi to Senju station, and 1,979 meters from Senju to Ishibashi via Takakizawa.

Among lines built by the Shinano River Electric Company, the one 12,000 meters long from Senju (backyard of the old office) to Kaino (left, or upstream, side of the inlet dam) was repaired. The line from Tohkamachi to Senju extends further to the inlet and forms a 1.067 meter gage transportation medium along the waterway. The one 1,320 meters long, with a 1.067 meter gage, from Echigotazawa on the Riyama line extends to Ohradai (on the right, or downstream, side of the inlet dam).

Another section of water tunnel showing completed portion of water main, September 11, 1933

On the other hand, a funicular line spanning the Shinano River was constructed between Ohara and Kaino. Thus transportation between Tohkamachi and Echigotazawa was effected by cable—as well as railway line. This work was completed between June, 1931, and October, 1932. The Shinano River bridge between Tohkamachi and Senju is 431 meters long having 20 spans of plate girder decking, 10 each of 70 and 60 feet. A well foundation is sunk at each pier. In designing this bridge, the extra load of steel pipe for irrigation purposes in the future was considered.

POWER INSTALLATION FOR CONSTRUCTION WORK.—To distribute power for construction work, a transforming station of 3,450 kva capacity is installed at the village of Mizusawa. It distributes electric power where needed by means of a power line 13 kilometers long laid alongside the waterway, which carries 66,000-volts from the Tokyo Electric Light Company and transforms this current to 3,300-volts. In addition it was decided to get more power from the Unuma Electric Power Company at Asagawara. All of this equipment has been in use since February, 1932.

COMMUNICATIONS.—Wires for inter-office telephone service, for stations, storehouses and official residences have been put in.

(*b*) CONSTRUCTION PROPER.—Digging of waterways was commenced everywhere needed after the lower part of the third tunnel was driven under direct control in August, 1931. Subsequently contractors decided to begin work on the dam, the sand pond and the tunnel between the sand and regulating ponds.

INTAKE DAM.—In building the intake dam, the section on the right (downstream) side of the river was started first. This section contains the non-overflow dam, the fishway, the raftway and the five spillway gates.

When the right side of the dam is completed, the river will be diverted above the spillway, which is already finished, and the left (upstream) side will be constructed. It involves four spillway gates and the scouring sluice gate. Construction of the right side was begun in March, 1932, and is still under way. The non-overflow dam is finished and the fish ladder and the raftways are now being concreted, their excavation having been done. The gravel layer near the riverflow is being excavated to bedrock for spillway foundations by using sheet steel piles to a depth of about 10 meters below normal water level. Excavation and concreting of the portion adjacent to the river is almost finished, notwithstanding the fact that much gushing water was encountered.

SAND POND.—Recently a contract was let for construction of the sand pond. Preliminary work and excavation for it are now in progress.

TUNNEL.—The tunnel is being driven by adits, or nearly horizontal and vertical shafts, to the centerline, except at the Asagawara portal. The work is being undertaken in five stages, as it was convenient to sink a shaft in every gulch. Work is progressing on all but the lower part of the third tunnel, which is 345 meters in length. Operations have been under direct control since August, 1931, especially to ascertain the character of the soil in the vicinity.

Scenes where a water tunnel is under construction at Sugata: Left, mouth of horizontal shaft No. 2, June 7, 1932; Right, empty muck train returning to scene of work

Panorama of preliminary work under way at site of Asagawara regulating pond with the Shinano River in distance. Ledges along mountain sides on right and left of picture indicate the top level of the earth dam being constructed, October 27, 1933

Panoramic view of site of Asagawara regulating pond photographed from crest of earth dam being built, October 27, 1933

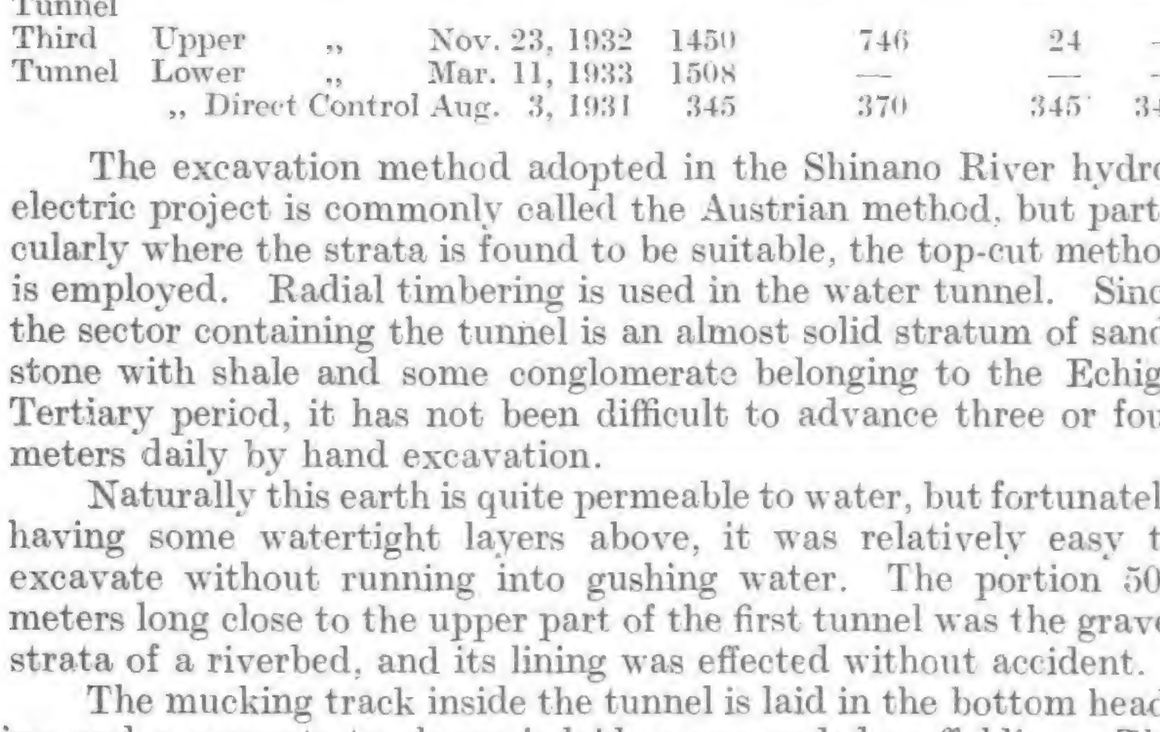
TABLE OF TUNNEL-DRIVING PROGRESS ON MAY 15, 1933

Kind	Execution Method	Date of Starting	Lgth. (m.)	Progress (m.) Heading Completion	Enlargement	Lining
First Tunnel	Upper Contract	Dec. 8, 1931	1452	Dec. 1, 1932	827	643
	Lower ,,	Apl. 1, 1932	1630	1337	1194	554
Second Tunnel	,,	Apl. 14, 1932	800	Completion Feb. 11, 1933	672	486
Third Tunnel	Upper ,,	Nov. 23, 1932	1450	746	24	—
	Lower ,,	Mar. 11, 1933	1508	—	—	—
	,, Direct Control	Aug. 3, 1931	345	370	345	345

The excavation method adopted in the Shinano River hydro-electric project is commonly called the Austrian method, but particularly where the strata is found to be suitable, the top-cut method is employed. Radial timbering is used in the water tunnel. Since the sector containing the tunnel is an almost solid stratum of sandstone with shale and some conglomerate belonging to the Echigo Tertiary period, it has not been difficult to advance three or four meters daily by hand excavation.

Naturally this earth is quite permeable to water, but fortunately having some watertight layers above, it was relatively easy to excavate without running into gushing water. The portion 500 meters long close to the upper part of the first tunnel was the gravel strata of a riverbed, and its lining was effected without accident.

The mucking track inside the tunnel is laid in the bottom heading and a concrete trackway is laid on suspended scaffolding. The concrete mixing plant was usually placed on the ground surface just above the centerline of the tunnel. Connecting the plant with a trackway by a vertical shaft, concrete is hauled wherever it is needed. Rocks not being so hard in this section, excavation is progressing according to the standard method, side walls and arch being concreted close to the ground level without any backfilling. The center was standardized to the normal form of a metallic frame, which the contractor provided.



Construction railroad bridge being built to span Shinano River

(c) WORK REMAINING.—Construction of the earth dam for the regulating pond and the pressure tunnel will be started in the near future. This will be followed by the tailrace, the regulating pond, the connecting reservoir, the surge tank, the pipeline and the power plant.

The course of the transmission line between Senju and Tokyo is now being surveyed. The part along the frontier of the Joetsu region, in particular, requires sufficient investigation, because of its steepness, snow and severe winds. An experimental steel tower, therefore, was erected last fall in the Shimidzu mountain pass for research purposes.

Method of Execution by Contract or by Direct Control

Item	Execution Method	Contractor	Cost of Construction	Date of Starting	Term (Month)	Expected Date of Completion
Right Side of Dam	Contract	G. Kurihara	Y.178,582	Mar. 16, 1932	21	Dec. 15, 1953
Sand Pond	,,	S. Sato	289,420	Feb. 28, 1933	39	June 27, 1936
First Tunnel Upper	,,	Hazama Co.	313,100	Dec. 8, 1931	43	Dec. 7, 1935
First Tunnel Lower	,,	Nishimatsu Co.	336,110	Apr. 1, 1932	44	Nov. 30, 1935
Second Tunnel	,,	Hoshino Co.	162,337	Apr. 14, 1932	39	July 13, 1935
Third Tunnel Upper	,,	Tobishima Co.	258,056	Nov. 23, 1932	44	July 22, 1936
Third Tunnel Lower	,,	Railway Industrial Co.	274,918	Mar. 11, 1933	47	Feb. 10, 1937
Third Tunnel Lower	Direct Control	—	Estimate 92,026	Aug. 3, 1931	—	Completion Feb. 18, 1933

Hydraulic Machinery

Messrs. Edwin Mills & Son, Ltd., of Aspley Ironworks, Huddersfield, England, have been makers of Hydraulic Machinery of all descriptions since 1810.

They are also the sole makers of " Roberts " Patent Mechanical Presses, as supplied to the Government of Japan at Kobe. Several Plants, made by this Firm, have been installed in various parts of China, for pressing Cotton Piece Goods.

Another of their specialities is a Press which has been specially designed for the production of " Holite " Printing Plates. This Press can also be used for ordinary stereotyping with wet or dry flong, and for lead moulding. These Presses have been supplied to customers in various parts of the World, which are turning out " Holite " Plates on an increasing scale.

This Firm supplies Presses, Pumps, Accumulators, Intensfiers, or Valves, for Baling, Packing, or Pressing.

Southern Railway Electrification Extensions

Peebles-Brown Boveri Rectifiers for Power Supply

An important contract has been received by Bruce Peebles & Co., Ltd., Edinburgh, for the manufacture, supply and complete erection of 23 rectifier equipments for the Eastbourne-Lewes-Hastings, and Sevenoaks electrification extensions of the Southern Railway Co.

This contract, representing as it does, 57,500 kw. of Rectifiers, is the largest of its kind ever placed in Great Britain, and follows the order Bruce Peebles received in co-operation with Brown-Boveri, for 18 rectifier equipments for the London-Brighton-West Worthing extension of the Southern Railway Co., which was opened in January 1933.

The contract embraces 23 Peebles-Brown Boveri Steel Cylinder Type Mercury Arc Rectifiers with main and auxiliary transformers, recooler equipments, control panels and accessories. Each rectifier will be designed for a normal D.C. output of 2,500 kw. at 660-volts and overloads up to 8,000 kw.

The main transformers will be of the oil-immersed self-cooled type designed to operate on the H.T. side at 33,000-volts, three-phase, 50-cycles, and the secondary windings will be double six-phase connected, there being 12 anodes on each rectifier.

Each equipment will be completely automatic in its operation, once the main circuits have been operated by remote control.

Philippines Productive Gold Mines

(Continued from page 128)

Cross, 20 tons a day. The IXL mine in the Araroy district is also producing steadily, with a small mill. Here are 10 mills in actual operation, practically five new ones during the year—a first rate showing, especially notable from the fact that capital ventured is nearly all local capital.

P. I. GOLD BULLION EXPORTS 10 MONTHS 1932 AND 1933

Month	1932 Ounces	1932 Value	1933 Ounces	1933 Value
January to June ..	204,136	P.4,616,777	213,533	P.4,824,369
July	35,855	825,629	34,173	801,230
August	38,192	892,254	39,527	902,056
September	40,087	893,290	34,874	800,501
October	38,089	896,474	31,399	712,710
10 months	356,359	P.8,124,414	353,506	P.8,040,668

Customs Data.

Economics of Electric Resistor Furnace Design and Construction in Japan*

By JAMES A. RABBITT, Adviser to Japan Nickel Information Bureau, Tokyo

PART TWO

(Continued from February, 1934)

STANSEL† gives the following formula for the quantity of heat which is absorbed by a substance and which is effective only in raising the temperature of the substance, as :

$$h_a = \frac{W \times C_m \times (t_f - t_a)}{K}$$

h_a =Kilowatt-hours
W=weight
t_a =initial temperature
t_f =Final temperature
C_m=mean specific heat of the substance for the temperature range noted
K=3412 for the British system of units. For the c.g.s. system, K=860

Stansel‡ also gives a graphic heat balance diagram, as shown in Fig.5.

Stansel§ gives a table of efficiencies as shown in the following table, drawing attention to the fact that conditions are so variable that these operation values are very general.

AVERAGE OPERATING EFFICIENCIES

Process	*Type of Furnace*	*Lb. per Kw-hr*
Annealing copper and brass	Batch	15 to 40
	Batch	7 to 11
Annealing steel and cast iron	Continuous	10 to 25
Hardening steel	Batch	7 to 11
Tempering steel	Batch	20 to 35
Galvanizing	Batch	15 to 22
Porcelain enamel-sheets	Batch	3 to 6
	Continuous	15 to 20 (gross)
Carburizing	Batch	4 to 6 (gross)
	Continuous	8 to 11 (gross)

Trinks¶ gives general rules for determining the heating capacity of furnaces, for heating iron and steel by which the capacity per square foot of hearth area may be determined. He gives this for resistor furnaces at 69 to 55 lbs. steel per sq. ft. of hearth area for continuous furnaces and 43 lbs. per sq. ft. of hearth area for intermittent furnaces. Naturally the conditions are so variable that there is no general rule that will fit all cases.

Wilcox** states : "Transfer of Heat to the Charge :—Heat is transferred to the charge in electri : furnaces and muffle-type fuel furnaces chiefly by radiation, a very small part being transferred by convection. The circulation of the furnace atmosphere is created only by differences in temperature within the chamber, and as these differences in a properly designed furnace are very slight, the amount of heat transferred by convection is correspondingly small. It is, therefore, essential that the charge should be exposed to "the radiant heat as much as possible because exposed surfaces absorb it more rapidly than shaded ones and because the charge is heated faster and more uniformly. When heating elements are mounted below refractory metallic hearth plates, as well as along the side walls, considerable heat is transferred to the charge by conduction, provided the charge is rested directly on the hearth."

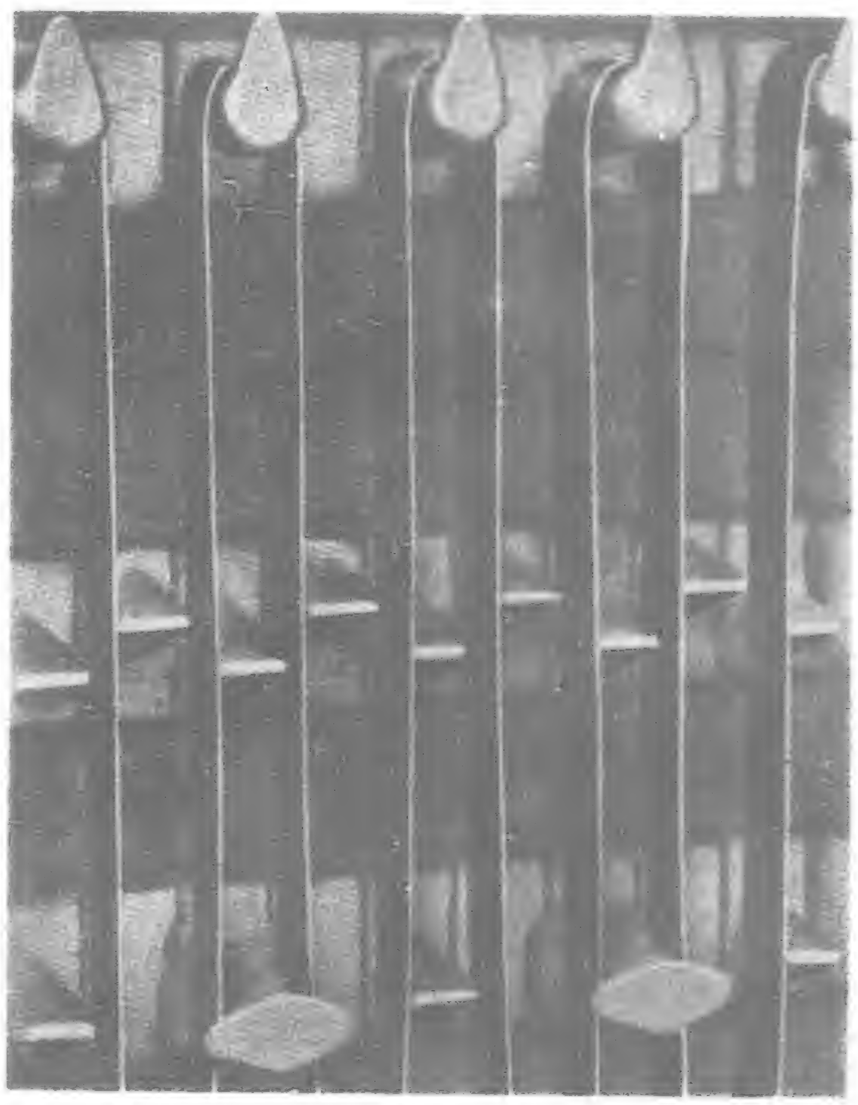


Fig.—6

Electric Furnace Resistors

This paper deals only with furnaces in which auxiliary elements act as resistors, and further that these elements are metallic. No attention is given to non-metallic resistors although the recommendations made regarding design and insulation will apply also to other types of furnaces.

The earliest use of electric resistance alloys, resulted from Marsh's experiments and patents in 1906, which were composed of practically 100 per cent combined nickel and chromium in the proportions of 80 per cent nickel and 20 per cent chromium.

The original investigations by Marsh had for their purpose the provision of a high degree of surface stability and electric resistance at elevated temperatures. However, the use of alloy castings for other than electrical purposes soon brought to light other combinations of alloys.

There has been no one alloy discovered which will serve under all conditions. Therefore, the selection of the correct alloy for a particular service must depend upon the individual conditions existing and the requirements of each case. High temperature is not the only condition that must be met in the selection of an alloy. For instance, an alloy which might be destroyed quite rapidly in a strongly oxidizing atmosphere of 1900°F. might be used with safety at 2100°F. in the same furnace with a reducing atmosphere. Conversely, a metal capable of service at 1900° F. in a neutral or oxidizing atmosphere might be quickly destroyed at even 1400° in a reducing atmosphere in the presence of a high percentage of sulphur. It is, therefore, apparent that temperature alone is not the chief factor in determining the suitability of an alloy.

SELECTION OF METALLIC ELECTRIC RESISTOR ELEMENTS

In general there are two types of metallic resistors for heat elements :

(*a*) Malleable
(*b*) Cast

MALLEABLE RESISTORS

There are several groups of malleable alloys in general use as electric furnace resistors :

Grade—1. An alloy of 85-80 per cent nickel, 15-20 per cent chromium.

Grade—2. Alloy of 70-60 per cent nickel, 10-20 per cent chromium, and balance iron.

Grade—3. Alloy of 40-35 per cent nickel, 12-18 per cent chromium, and balance iron.

Grade—4. 24-20 per cent nickel, 8-25 per cent chromium and balance iron.

Grade—5. 12-10 per cent nickel, 18-25 per cent chromium and balance iron.

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*The Japan Nickel Review.
†N. R. Stansel, Industrial Heating, p. 14.
‡N. R. Stansel, Industrial Heating, p. 136.
§N. R. Stansel, Industrial Heating, p. 230.
¶W. Trinks, Industrial Furnace, pp. 37-38, 40-41.
**Edgar A. Wilcox, Electric Heating, McGraw-Hill Book Co., Inc., N.Y., 1928, p. 206.

Table II gives the analysis of electric resistance materials imported into and manufactured in Japan, and Table III gives a number of these alloys with typical applications, as used in America.

Many live tests have been made of the above-mentioned resistor elements. The standard test by the American Society for Testing Materials, based on tests made for pure oxidation under atmospheric conditions in which three of the above grades give the following results:*

	Ni	*Cr*	*Fe*	*Useful life, hours*	*Relative life*
Grade 1 ..	80	20	1	95	7.6
Grade 2 ..	59	16	23	40	3.2
Grade 3 ..	34	20	42	12.5	1

This test has no bearing on the load carrying ability, nor on the life under corrosive or special conditions, but is an accelerated test for comparison only. There have been exhaustive tests made in Japan, particularly those by Horioka (and his colleagues), Shinji Togo, Asaki, a summary of whose tests have been published.†

Malleable resistors are made up of either rod, strap ribbon, or wire. Grade 1 is used almost exclusively for temperatures from 1000 to 1950° F. (538°-1063° C.) regardless of the application, and Grades 2 or 3 for medium and low temperature work respectively, and for easy applications. For large furnaces of all types, however, Grade 1 is recommended.

These resistor materials are reasonably durable if properly designed and applied. Several years' life can be expected under average conditions. However, the problems of expansion, and creep and growth, are still unsolved and little understood. There are also many who are disappointed in the life of these materials because makers often recommend them for temperatures higher than those at which they will work with safety. This applies particularly to ceramic firing and forging of steel, or high speed steel hardening, all of which require temperatures of from 2000 to 2500 degrees F. (1090 C. to 1370 C.).

*A. S. T. M. Tentative Accelerated Life Test for Metallic Materials for Electric Heating, p. 113, Symposium on Effect of Temperature on the Properties of Metals—A. S. T. M. Chicago 1931.

†*Japan Nickel Review*, October, 1933.

TABLE II.—CHEMICAL ANALYSIS OF RESISTANCE MATERIALS IN USE IN JAPAN

Name	*Manufactures*	*Constituents / Date of Test*	*Ni*	*Cr*	*Fe*	*Cu*	*Mn*	*Si*	*B. S. No.*	*Ohms/meter*
				FOR HIGH TEMPERATURE						
"Taikalloy" Ta	Taika Denki Yakin Koshi	1926	72.442	22.187	2.970	0.060	1.817	0.704	21	—
		,,	74.800	21.770	1.760	Trace	1.320	0.350	22	3.481
Nihon Dennetsu Sen No. 1	Nihon Dennetsu Sen Seizo K.K.	1926	77.785	18.392	2.213	—	1.337	0.273	21	—
		1927	75.530	19.600	2.640	0.060	1.940	0.230	22	3.183
		1930	80.030	17.607	0.700	0.050	1.452	0.161	20	1.834
		,,	78.750	16.954	1.044	0.009	3.131	0.112	18	1.140
		,,	78.824	18.165	0.957	0.030	1.860	0.164	16	0.820
		,,	80.190	17.406	0.957	0.025	1.392	0.030	14	0.590
		,,	78.577	17.259	1.369	0.027	2.695	0.073	12	—
(Nichrome IV)	Driver Harris Co.	1926	77.044	19.873	0.977	0.050	1.765	0.291	21	—
		,,	77.88	19.08	1.360	0.080	1.320	0.280	22	3.319
(Chromel A)	Hoskins Manufacturing Co.	1926	77.104	19.636	1.256	0.040	1.837	0.127	21	—
		,,	76.960	19.950	1.360	0.030	1.540	0.160	22	3.220
		1930	78.255	19.110	0.044	0.050	2.110	0.430	22	3.377
		,,	78.616	18.914	1.055	0.030	1.035	0.350	19	1.718
(Solar)	Gilby Wire Co.	1926	79.952	17.655	1.400	0.310	0.683	Trace	21	—
(Brightray)	Henry Wiggin Co., Ltd.	1926	77.121	19.268	2.511	0.360	0.566	0.174	21	—
Furukawa Dennetsu Sen No. 1	Furukawa Denki Kogyo K.K.	1932	82	18	—	—	—	—	21	2.481
Tophet A	Gilby Wire Co.	1932	80	20	—	—	—	—	22	2.6253
				FOR MEDIUM TEMPERATURE						
"Taikalloy" Te	Taika Denki Yakin Koshi	1929	55.06	17.21	24.29	Trace	1.52	1.92	22	—
Nihon Dennetsu Sen No. 2	Nihon Dennetsu Sen Seizo K.K.	1927	73.822	14.000	10.620	—	1.507	0.051	21	—
		1929	70.97	16.79	10.05	0	2.05	0.14	22	2.991
		1930	64.864	18.471	14.000	—	2.556	0.109	20	2.225
		,,	68.558	16.935	11.310	0.023	3.010	0.164	18	1.363
		,,	68.326	18.338	10.614	—	2.570	0.152	16	0.889
		,,	72.265	15.830	10.527	0	1.261	0.117	14	0.586
		,,	69.340	16.946	11.976	—	1.658	0.080	12	—
"Nicrotantan" No. 2	Kawagawa Denki K.K.	1928	25.014	4.928	64.565	0.180	0.245	5.068	22	3.494
(Nichrome)	Driver Harris Co.	1926	61.933	12.088	23.715	0.330	1.817	0.117	21	—
		1929	60.560	16.90	20.10	—	2.150	0.290	22	—
(Chromel C)	Hoskins Manufacturing Co.	1926	62.170	10.596	24.552	0.120	2.384	0.178	21	—
		1929	59.95	15.67	21.78	0	2.450	0.150	22	—
		1930	58.153	15.397	23.754	—	2.612	0.084	22	3.525
		,,	59.888	14.742	22.415	0.070	2.768	0.117	19	1.782
(Glowray)	Henry Wiggin Co., Ltd.	1926	66.273	11.585	20.088	0.980	1.003	0.071	21	—
		1929	65.64	13.050	18.990	0.28	1.12	0.92	22	—
(Tophet)	Gilby Wire Co.	1926	61.150	14.835	22.041	0.070	0.965	0.939	21	—
(Calido)	Electrical Alloy Co.	1926	61.820	12.933	23.436	0.210	1.522	0.080	21	—
		1929	62.870	10.85	23.17	—	2.430	0.680	22	—
Furukawa Dennetsu Sen No. 2	Fukukawa Denki Kogyo K.K.	1932	64	11	25	—	—	—	21	2.548

TABLE III.—COMPOSITION AND TYPICAL APPLICATIONS

Manufacturer	*Trade Name of Alloy*	*Nominal Chemical Composition, Per cent*	*Typical Applications*
Allegheny Steel Co.*	Allegheny 44	Ni 10-13, Cr 25.0, Mn 1.12, Si 0.50, C 0.20,‡	Furnace parts, recuperators, industrial oven linings, stack dampers, pump parts, etc.
American Manganese Steel Co.†	Fahralloy	Ni 70-Cr 18	—
Babcock & Wilcox Tube Co.*	No. 1100 Alloy	Ni 23.0, Cr. 22.0, Mn 0.50,‡ Si 1.85, C 0.65‡	Furnace rolls, grates, retorts, skid rails, discs, chains and other high temperature furnace parts.
Burgess-Parr Co.*	Illium "G"	Ni 60.0, Cr 25.0, Cu 8.0	Chemical pumps, nozzles, for severe corrosion conditions.
Calorizing Co.*	Calite "A"	Ni 35.0, Cr 15.0, Fe balance	—
	Calite "B"	Ni 8.00, Cr 20.0, Fe + Al balance	Carrying heavy loads at high temperatures.
	Calite "N"	Ni 65.0, Cr 18.0, Fe balance	Furnace parts and heat treatment equipment subject to sudden temperature changes.
Chicago Steel Foundry Co.†	Pyrasteel	Chrome Nickel Silicon Alloy	Carburizing boxes, annealing pots, skid rails.
Cooper Alloy Foundry Co.*	Sweetaloy 18	Ni 22.0, Cr 10.0	—
	Sweetaloy 20	Ni 36.0, Cr 18.0	—
	Sweetaloy 21	Ni 65.0, Cr 15.0	—
	Sweetaloy 22	Ni 10.0, Cr 28.0	—
Crucible Steel Co. of America*	Rezistal No. 7	Ni 17.5, Cr 25.0, Si 1.5, C 0.20,‡	High temperature in furnace parts, retorts, hydrogenation plants, and coal distilation.
	Rezistal No. 4	Ni 25.0, Cr 17.0, Si 2.5, C 0.20	Case-hardening boxes; belt, chain and roller hearths in heat-treating furnaces.
Cyclops Steel Co.*	Cyclops No. 17 Metal	Ni 20.0, Cr 8.0, Mn 0.75, Si 1.00, C 0.40	Valves, valve parts, turbine blading, pump rods, still plugs, thermocouple wells, miscellaneous refinery and steam application, rotor blocks and other non-magnetic appliances.
Driver-Harris Co.*	Nichrome IV	Ni 80.0, Cr 20.0	High temperature electrical devices.
	Nichrome	Ni 60.0, Cr 15.0, Fe balance C 0.12	Pickling machine parts, Valves, annealing pots, rheostats, heating units.
	Nichrome	Ni 60.0, Cr 15.0, Fe balance C 0.80	Dipping baskets, carburizing boxes, retorts, heavy resistors, cyanide and lead pots, glass rolls, pyrometer tubes, furnace parts.
	Chromax	Ni 35.0, Cr 15.0, Fe balance	—
	No. 193 Alloy	Ni 30.0, Cr 2.0, Fe balance	Low temperature heating devices, heavy duty rheostats.
Duraloy Co.*	Duraloy N	Ni 11.00, Cr 22.5, Fe balance	—
Duriron Co.*	Durimet	Ni 25.0, Mo 1.0‡ Cu 1.0, Si 5.0	Resistant to weak sulphuric acid.
Electro-Alloys Co.*	Thermalloy "A"	Ni 40.00, Cr 17.0, Fe balance Mn 1.00, Si 1.00, C 0.40	Furnace parts, carburizing boxes and retorts, cyanide pots, resistance grids, conveyor parts and pyrometer tubes.
	Thermalloy "B"	Ni 65.0, Cr 19.0, Fe balance Mn 2.00, Si 2.00, C 0.80.	do.
General Alloys Co.*	Q Alloy Grade K 1	Ni 67.00, Cr 20.00, Mn 1.32, Si 1.75, C 0.50	Carburizing containers, any parts operating to 1205°C.
	Xite	Ni 38.0, Cr 18.0, Mn 1.12, Si 2.0, C 0.50	Furnace parts, pots, chain, rails, retorts, general mechanism for corrosion and high temperature service.
Heat Resisting Alloy Co., Inc.	Hardite	—	—
Hoskins Mfg. Co.†	Chromel	Nickel Chrome Iron	—
Hybinette Alloys Co.†	Nickel Chromium Alloys	—	—
Michiana Products Corp.*	Firearmor	Ni 60.0, Cr 20.0, Mn 1.75, Si 1.0, C 0.50	Furnace parts, carburizing and annealing containers, resistor elements, salt and lead pots.
Michigan Steel Casting Co.	Misco	Ni 36.0, Cr 16.0, Fe balance Mn 0.70, Si 1.50, C 0.50	Furnace parts, carburizing and annealing containers, chain guides.
	Misco "C"	Ni 9.0, Cr 29.0, Fe balance Mn 0.50, Si 1.50, C 0.50	Furnace parts.
	Nicral "C"	Ni 26.5, Cr 11.00, Mn 1.50, Si 1.50, C 0.30	Cementation boxes, lead pots, salt baths, pyrometer tubes, glass blowpipes, parts of mechanical stockers, conveyors, crucibles for casting white metal, metallic muffles, recuperator plates.
Midvale Co.*	ATV-1	Ni 36.0, Cr 11.0, Mn 1.50, Si 0.20, C 0.30	Parts of valves for steam engines, turbine blades, centrifugal pumps, exhaust valves, rheostats, heating elements.
	"B.T.G."	Ni 60.5, Cr 11.5, Mn 1.25, Si 0.65, C 0.30, W 2.5	Apparatus for chemical synthesis, autoclaves for chemical reaction, injector discharge tubes, apparatus subjected to static or dynamic stresses at high temperatures, valves, pressure generators, molds or other equipment in glass industry.
	ATV-3	Ni 26.5, Cr 14.0, Mn 1.30, Si 1.35, C 0.47, W 3.40	Gas engine valves, gas turbine rotors, Diesel engine valves, steam turbines.
National Alloy Steel Co.†	NA Alloys Series	—	—
Ohio Steel Foundry Co.*	Fahrite N-1	Ni 35.0, Cr 15.0, Fe balance	Carburizing containers, furnace parts, high temperature valves.
Ohio Steel Foundry Co.†	Fahrite	—	Stirring arms, pots, retorts and furnace parts.
Pacific Foundry Co.†	Pyrocast	Nickel Chrome Iron	—
Western Crucible Steel Co.	Westeeco No. 5	—	—

Cast Resistors

These alloys are usually of grade two, employing 68 to 66 per cent nickel, 19 to 21 per cent chromium, and the balance iron, and are for severe applications and high temperatures, or of grade three with 38 to 35 per cent nickel, 17 to 20 per cent chromium, and the balance iron, for medium and low temperatures.

These cast resistors are usually larger and heavier than the malleable elements ; consequently the problem of oxidation is small. On the other hand, the problems of growth, creep, expansion, warping and cracking are more severe.

With cast resistors it is generally more difficult to connect sections of the heaters together, or to bring out the terminals.

Range of Furnaces

It is beyond the scope of this paper to cover the conditions of all ranges of electric heating furnaces. But the application of insulation and selection of resistor elements for the following classes can be determined from the data presented in this paper.

In Classes A, B and C, low temperature, the electric resistor problems of life are unimportant. Insulation in such furnaces may be accomplished by the use of asbestos or mineral wool, magnesia, felt, or many of the ordinary insulating materials such as are used for pipe covering.

In Class D, medium temperature furnaces, there are many problems of the selection of proper alloys in addition to the selection of the correct resistor elements, particularly for carbonizing boxes, conveyors, nitriding vessels, hearth plates, work supporting racks, skid rails, guard rails, boxes, baskets, chutes, rollers of all types, wire and cast link belts, chains, etc. Alloys recommended for the various parts, in addition to the alloys for resistor elements, are listed in Table IV.

*From Proceedings, Vol. 30, Part I, 1930 of the American Society for Testing Materials.

† From Supplement to the September, 1930, number of Machine Design.

‡ Maximum.

TABLE IV.—RESISTOR FURNACE CLASSIFICATIONS

	Class	Temp.	Purpose	Makers: U.S.A.	Makers: Japan	Makers: England	Insulation	Resistors	Alloys for Furnace Parts§	Usual Cause of Failure of Alloys
A	Ovens	55—455°C	Drying-Japanning Core Baking Tempering	GE 288-1168-G2-3-4 GE 288-1169-G2-3-4 Up to 425°C (*)	YASUDA T.Y.F. (**)	BIRLEC L. T. 1, 2, 3, 4. (****)	Mineral Wool 85% Magnesia	Grade 3 (40-35 Ni, 12-18 Cr, Balance Fe)	Shelves—Lift Racks—Trucks—Overhead Conveyors Stainless Steel if corrosive elements are present	Moisture often accumulates in the insulating material at low temperatures (or during shut-downs) which gives off steam during operation, and which also tends to corrode the plate used for walls.
B	Low Temp.	370—705°C	Drawing Furnaces Nitriding Furnaces Low Temperature Annealing Steel and Glass	GE-388-4775-G1 Ge-382-4776-G1 GE-388-4728-G2 Up to 650°C GE-3887 141 G1 GE-3887 142 G1 Up to 650°C	YASUDA T.Y.L.	BIRLEC F.C.U.D., 20, 60 BIRLEC "SEMI-CONTINUOUS" BIRLEC "BRYTREAT"	Asbestos and Clay Cements	Grade 2 (70-60 Ni, 10-20 Cr, Balance Fe) 540—6.	18-8 Chromium Nickel Monel Metal for Nitriding Box and Aux. Parts 66 Ni, 18 Cr for Nitriding Box and Aux. Parts 50-60 Ni, 18-22 Cr for Nitriding Box and Aux. Parts 14 Ni, 6 Cu, 2 Cr Balance Fe for Belt runs† Chains or Rollers in Lehrs—or Beams and Supports subjected to 540-650°C	Warping due to improper design Box or gas container subject to action of Nitriding Gases
C	Pot	595—900°C	Lead—Rabbitt Cyanide Barium Galvanizing Other Salts	GE-RRC 12 to 42 Up to 1010°C GE 2666 487 G1 Up to 900°C GE 2881 143 G2 Up to 900°C	YASUDA T.Y.M.	BIRLEC "POTYPE"	Diatomaceous Earth Cements Natural Diatomaceous Earth	Grade 1 Cast in as sheath wire in Cast Iron	Lead pots 66 Ni, 20 Cr, will usually give 3000 to 6000 hours at 815°C Zinc Tanks—Low Carbon Steel Plate	Failure to clean pots daily. Impurities in lead such as bismuth, antimony, etc.—Porosity in cyanide pots. Unequal temperature on pots.—i.e. flanges 370 to 480°C and body 815 to 870°C Life of zinc tanks shortened by increase of temperature from almost everlasting at 425°C down to 20 days at 540°C
D	Medium Temp.	735—1065°C	Hardening Furnaces Vitreous Enameling Furnaces Carburizing Furnaces Normalizing Furnaces High Temp. Annealing Furnaces	GE-RRB Small-Large (up to only) 1010°C	YASUDA T.Y.G.—A T.Y.V.—A	BIRLEC R.P. 1, 2, 3, 4. BIRLEC "CARBURIZING" BIRLEC H.C.P. 1, to 6A S.A. 10, 20, 40, 60	Calcined Diatomaceous Earth Brick	Grade 1 (85-80 Ni, 15-20 Cr)	Hearth Plates—Work Supporting Racks—Element Guards—Skid Rails—Guard Rails—Carburizing Boxes—Baskets—Chutes—Rollers—Wire and Cast Link Belts, Chains, etc. In atmospheres free of Sulphur 66-68% Ni, 19-21% Cr for higher temperature range and 37-38% Ni, 17-19% Cr for lower temperature range. In presence of sulphur use 25% Cr, 12% Ni or 18% Cr, 8% Ni, 24% Cr, 12% Ni. For Carburizing boxes 60 Ni, 12 Cr, Balance Fe.	Chemical failures due to excessive oxidation or corrosion. Formation of heavy oxide scale, due to presence of corrosive media Mechanical failures due to deformation or breakage, due to improper design, unequal heating and cooling, inadequate sections, change in physical properties due to prolonged use and inherent defects in fabricating the alloy.
E	Med. Heavy Duty	1095°C		Heavy-Duty Electric Co. HD 96 to 128 (***)	YASUDA T.Y.G.—A or B T.Y.V.—A or B		Laminated			
F	High Temp.	1035—1370°C	Forging High Speed Hardening Ceramic Firing	YASUDA T.Y.G.—B T.Y.V.—B	BIRLEC-HS-40	Diatomaceous Earth Sil-O-Cel (Super-Brick) Sil-O-Cel (Standard Brick Quality)	"CALITE" up to 1200°C (Cast) Carbon Resistor Globar (Silicon Carbide)	Chronite Cars, Supporting Racks, Sand—Seal Plates, Pans and Trays, Kiln Doors, Dampers in Flues, Goose Necks, Fans and Kiln Equipment—All of High Heat Resistance—66-68% Ni, 19-21% Cr Dampers of Refractory Bricks supported by Cr, Ni Rods of 25 Cr, 17 Ni, 0.20C Rods for reinforcing refractory at 1205°C—17.5 Ni, 25 Cr, 0.20C Bottom grids of heat resistant metal—to protect bottom heating elements Furnace parts which have given satisfaction are:‡ Cr Ni Mn Si C (1) 18-22 30-34 2-3 1.5-2.5 0.40 Max. (2) 17-19 37-39 1 2 0.50 (3) 15 35 — — — Supporting rods of rolled alloy of Cr Ni Fe 20 25 55 having given satisfaction	Stresses set up by alternate heating and cooling-oxidizing and corrosive action of the kiln gases.

Foot Notes:

†Alloy Cast Iron Ni-Resist—

Ni	Cu	Cr	
14	6	2	have lasted 6 to 7 months against 7 to 10 days for ordinary Cast Iron

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‡Symposium A.S.T.M. and A.S.M.E. July, 1931 p. 210

A.S.T.M. and A.S.M.E., 1931, p. 210

§Consult Table III.

(*) GE=General Electric Co.
(**) TY=Yasuda Seisakujo.
James A. Rabbitt—Japan Nickel Information Bureau.
(***) HD=Heavy Duty Electric Co.
(****) BIRLEC—Birmingham Electric Furnace Co.

The economy of the use of electric resistor furnaces has been outlined in previous paragraphs, but in order to secure all of the advantages of the resistor furnace, it is necessary to obtain the maximum economy from the following factors :

(*a*) Economy to be obtained by simplicity in furnace design.
(*b*) Prevention of loss of available heat through furnace walls.
(*c*) Selection of the correct resistor element.
(*d*) Calculation of the most economical size of the resistor element selected.
(*e*) Economy in electrical energy consumed for a given amount of work.
(*f*) Maximum economy by obtaining the highest quality in the products which are to be heat-treated.

Items (*a*), (*b*) and (*c*) have already been covered. Now it becomes necessary to take up the question of the calculation of the resistor dimensions, which is of vital importance particularly in Japan where economic conditions relative to material and labor are the reverse of conditions in western countries. This is due to the well known principle in industrial economics, that where labor is cheap and material scarce, as in Japan, labor will be wasted and material conserved. Conversely, in a country where labor is expensive and material cheap, as in western industrial countries, labor will be conserved and the material used freely. As a result of this principle, the free use of material in western countries enables the designers to be liberal in the selection of the best alloys, first because material is abundant, and second, because the high cost of labor makes repairs and replacement uneconomical. The reverse of this condition prevails in Japan, that is, material being scarce, it is conserved to a point where either low grade material or correct material of the minimum size is used, which results in the necessity for frequent repairs and replacements. In the past these repairs may not have been a serious matter in Japan when labor was comparatively cheap, but with the present high wage scale it has become a vital factor in the economic welfare of the nation. Furthermore, when the industrial products of this country are sent to foreign markets, this tendency to break down places Japanese industry at a serious disadvantage in competing with western industrial countries.

As a result of this principle as stated above, there has been a tendency in Japan, in selecting resistor elements, to select the lightest possible weight of resistor elements in order to save on the first cost of the installation. That this is false economy will be shown by the following examples, which demonstrate that the increased cost of a resistor element which is heavier and higher in first cost, is far less in ultimate cost than the extra life obtained.

The present writer is fully aware of the many factors which determine the useful life of resistor elements and which cannot be overcome by merely selecting a heavier element. The fact remains however, as borne out by the writer's observation of resistor furnaces in the United States, England and Japan, that the practice in western countries is to select the heavier element. Wilcox* gives an example, which will be shown later in this section and adds : " It is obvious that the heavier and more costly ribbon would prove the more durable." Yet, Wilcox does not attempt to show how much more durable the heavier ribbon might be. Stansel† states on the subject of the mechanical strength of the resistor material at elevated temperatures that—" The area of the cross section of the conductor must be large enough to give adequate strength under all conditions." Trinks‡ devotes a whole paragraph to this matter in which he definitely associates the thickness of the resistor ribbon with hot spots :

Fig. 7

" It is especially desirable in the case of ribbon resistors to use a rather thick section. If thin ribbons are used, any spot which is thinner than the average, or which cannot dissipate its heat readily (as for instance the part of the ribbon shielded by the supporting pin), becomes hotter than the other parts, because heating is proportional to the resistance and because temperature is inversely proportional to heat abstraction. The hot spot oxidizes more rapidly than the colder parts ; the effective section is thereby reduced, its resistance is further increased, and the temperature is raised still higher : the action is cumulative, finally resulting in the burning out of the ribbon at that spot. Such burning out has actually occurred in many cases. In the thicker ribbons, either an initial variation in thickness or a decrease due to formation of a film of oxide would be much less serious, in proportion, than in the thin ribbons."

Dealing further with the question of the size of the element it must be recognized that its life is that of its hottest spot. It has been found that invariably as soon as one point in the element starts to overheat, so that oxidation is concentrated, the element soon fails, owing to the local increase in resistance and temperature. However, as pointed out by Trinks, the risk of hot spots is lessened by the heavier element.

Apart from the question of local overheating, the main aim of design should be to keep the temperature of the element itself as near as possible to that of the work, having also in mind that, if the furnace is used intermittently, it is useful to be able to heat it up rapidly from the cold.

The important factor in deciding on sectional area of the element will, of course, be the wattage per unit area of the surface of the element. This should be kept as low as possible. The heavier cross sectional areas favor

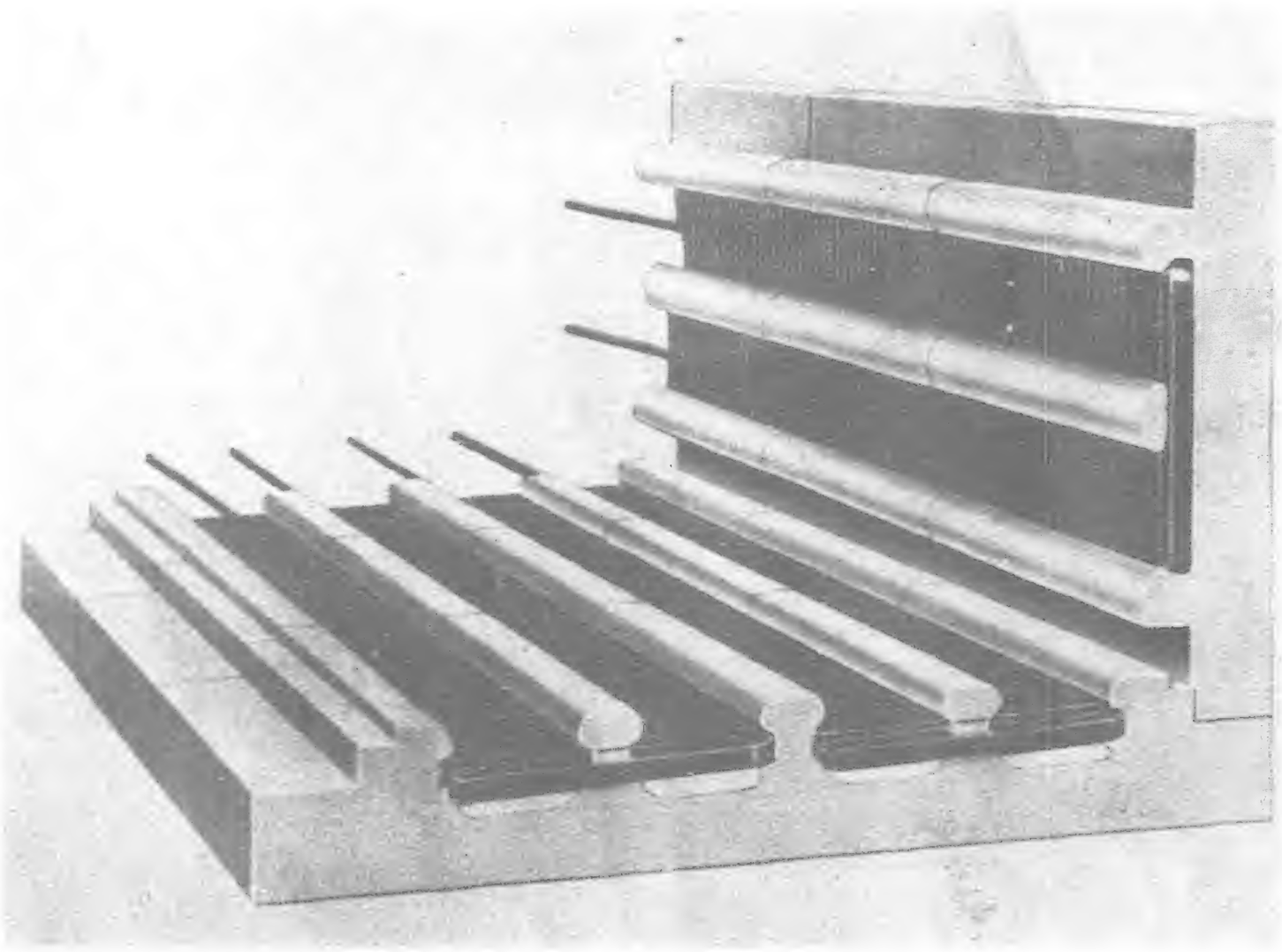

Fig. 8.—Heating elements

The heating elements consist of sinuous windings of heavy cross-section nickel-chromium strip, supported in slots in a special refractory, in a manner giving the minimum of masking (Patent No. 308009). They are located in the roof, sides and hearth, and cover the greater part of these surfaces, the surface area of the resistors being much greater than that of the walls on which they are mounted. The elements operate at a low wattage per square inch and are designed to give uniform heating and ensure long life with freedom from breakdown.

*Edgar A. Wilcox, Electric Heating McGraw-Hill Book Co., Inc., New York, 1928, p. 83—p. 83.

†N. R. Stansel, Industrial Electric Heating.—p. 153.

‡W. Trinks, Industrial Furnaces, Vol. II, John Wiley.—p. 156.

the lowering of this factor, as will be pointed out later.

The selection of the proper resistor element, its correct size, shape, and form of application, depends upon many variables, such as temperature requirements, that is :

(1) Furnance temperature
(2) Element temperature
(3) Refractory temperature
(4) Work temperature
(5) Temperature control—whether automatic or manual.
(6) Continuous or intermittent use
(7) Voltage conditions
(8) Mechanical stresses.

Selection of Kind of Resistor

Tables II and IV indicate alloys suitable for resistors in a wide range of industrial furnaces, but after the selection is made of the proper alloy it is then necessary to determine whether the resistor should be (*a*) rolled or drawn ; (*b*) cast ; (*c*) round, square, rectangular ; (*d*) straight, coiled, slotted or looped ; and (*e*) partially or totally enclosed. The following brief notes on each of the aforementioned items, in numerical sequence, summarize the salient factors to be considered.

(1) and (2) Furnace and Element Temperature.—As already stated, in this article, the deterioration and destruction of resistor elements is one of the important factors affecting the economy of electric resistor furnaces. It is a well known fact that the higher the temperature the more severe is the effect upon the resistor element. The nature of the deterioration may be due to one or all of the following :

(*a*) Oxidation
(*b*) Changes in grain structure
(*c*) Mechanical defects which are inherent in the production of the resistor element
(*d*) Hot spots due to (*c*) above, or to improper methods of supporting heating elements.

After selecting a suitable alloy to function within a certain range of temperature, as has already been outlined, the effect of the above-mentioned factors may be modified by the selection of resistors of suitable size to provide an increase in mechanical strength of the element due to its increased area, which will assist in meeting the severe conditions prevailing at the higher temperatures.

While required working furnace temperatures are usually known for a given service, the resistor temperatures are determined from calculations or by actual tests. Low temperature gradients between the resistor elements and the work in the furnace are desirable for prolonging the life of the resistor elements.

This condition is obtained by the elimination of unnecessary obstacles to the free flow of heat between the resistor element and the work. Trinks* gives 300° F., as the maximum limit of resistor temperature above the furnace temperature. Naturally this temperature difference will be greater in muffled than in unmuffled furnaces. 300° F. seems to be far too high. Stansel† gives 45 to 125° F. (25 to 75° C.), as within the range of good practice for the temperature gradient between the resistor and the heating chamber in direct heating (non-muffled) furnaces.

(3) Refractory Temperature.—The elements are usually mounted, adjacent to refractory surfaces, that both absorb and reflect the electrical energy which is dissipated. The nature of the refractory and also the position of the element has a marked influence upon its performance. This is particularly detrimental in cases where the element is partially enclosed in refractory groups. It is also severe when the element is mounted adjacent to refractory surfaces as in muffle resistor furnaces. Much depends upon the care taken in design to give as far as possible free space to the resistor element, with as little restriction to its expansion and contraction as possible, in order to eliminate mechanical stresses incident to operation. Practical methods for suspending resistor elements, as used by leading furnace makers as shown by Figs. 6 to 11.

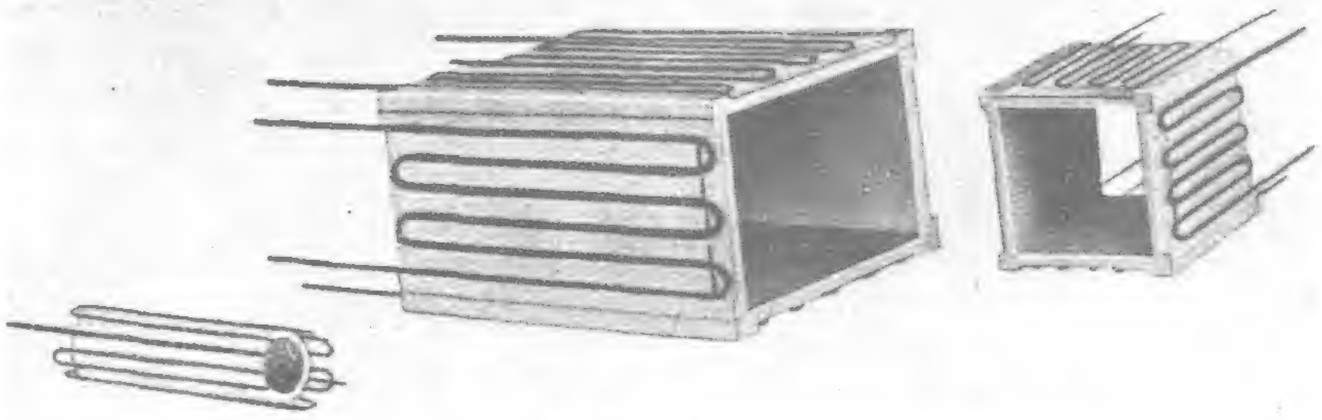

Fig. 9

(4) Work Temperature.—Work temperature is correlated to the furnace temperature and in practice it is usually necessary to raise the temperature slightly above that which is required. As already mentioned where this excess of temperature is considerable, it has a marked defect on the resistor, as the resistance of all conductors increases with the rise of temperature. This resistance change is more marked with pure metals ; consequently it is of greater importance in the higher temperature range. Therefore where possible a wide range of temperature change should be avoided.

(5) Temperature Control.—Difficulties arising from the temperature difference between the heating element and the final temperature of the charge are reduced by the installation of automatic temperature control. This is considered by the most advanced engineers to be a positive necessity in electrically heated furnaces. There are many types of such instruments on the market which can be easily adapted to any kind of furnace. GE and Leeds and Northrup are representative makers of this class of equipment.

(6) Continuous or Intermittent Use.—Resistors intended for furnaces in continuous service should be specially made of heavy sections and securely mounted and well protected, as deterioration is more rapid at continuous elevated temperatures. Therefore over-heating should be avoided whenever possible.

(7) Voltage Conditions.—It is always essential that the elements should be designed for the maximum voltages to be encountered.

(8) Mechanical Stresses.—Mechanical stresses due to elements which are subjected to hard usage may be relieved by making the elements of heavy sections and also by making ample allowance for expansion and contraction.

Selection of Resistor

(a) The rolled or drawn resistors are more homogeneous and uniform in cross section, and should be used where possible in all elements at high temperatures.

(b) Cast resistors have the advantage of rigidity and therefore can be placed in the furnace wherever necessary, either above or below the charges or between the parts of the charge if so desired. They are extremely subject to imperfections due to gasses and slag inclusions in the molten metal and irregularities in the mould, all of which are likely to cause hot spots and make such resistors unsuitable for high temperatures.

(c) Shape of resistor.—The shape of the resistor, that is whether round, square, or rectangular, depends largely on service

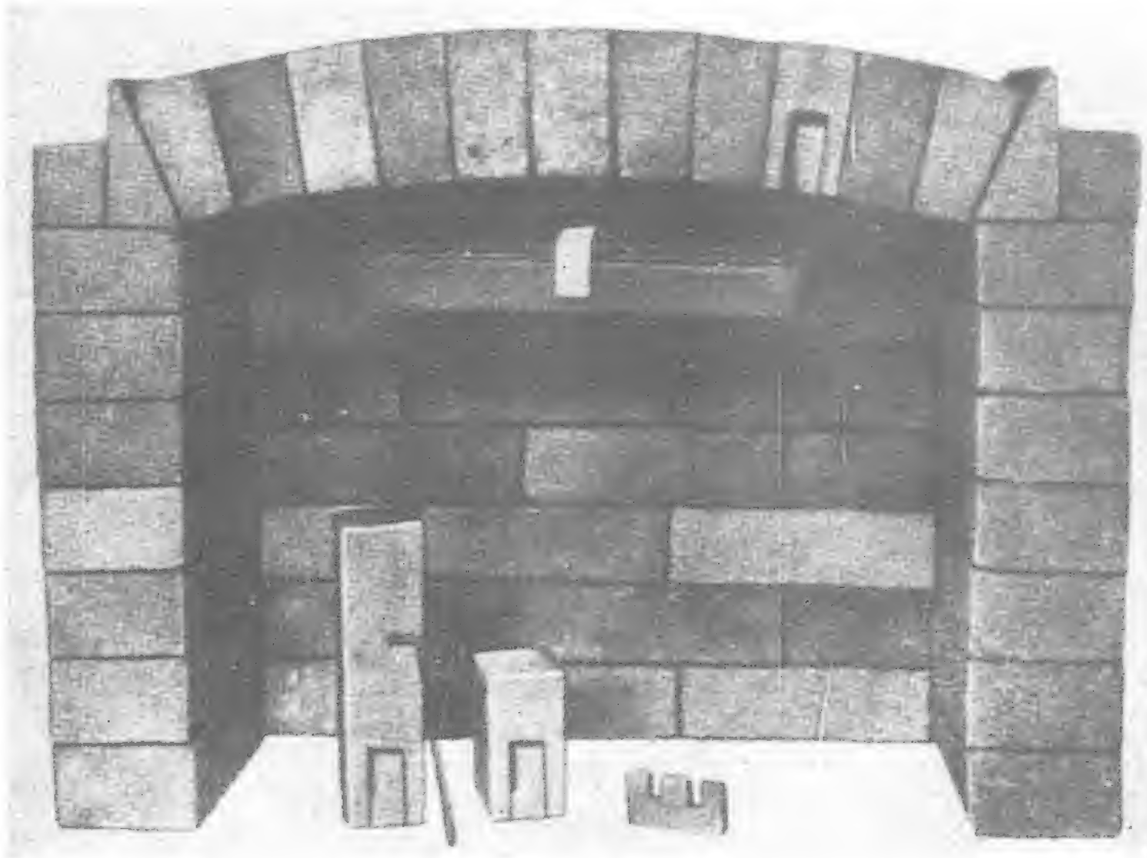

Fig. 10

*W. Trinks, Industrial Furnaces, John Wiley, 1926 Vol. II, p. 148.

†N. R. Stansel, Industrial Electric Heating, p. 159.

required. The greater the resistor area the more surface it exposes to oxidation; consequently a round resistor offers the minimum exposed area in proportion to its sectional area. Conversely a rectangular or flat resistor offers greater area, as its thickness is decreased and its width increased. Hence flat or rectangular ribbons are more durable when thick than are thin ones, when operated at the same temperature. They have greater mechanical strength, and the irregularities in thickness have less effect on the cross sectional area, thus minimizing the liability of hot spots.

The form of the resistor, that is whether straight, coiled, slotted or looped, is a matter of design, but often seriously affects the life of the element. An exposed metallic resistor dissipating a certain voltage will operate at a lower temperature when straight and at a higher temperature when wound or looped. The closer the convolutions of the coils or loops are to each other, the higher the temperature attained.

(d) Partial or totally enclosed elements are also matters of design, or, as previously stated, the element is influenced considerably by the material by which it is surrounded. Refractory materials surrounding the resistor elements should possess high thermal conductivity, otherwise the resistors will be unable to dissipate their heat as rapidly as it is generated, and consequently will be subject to an undue temperature rise.

Resistor connections or terminals between resistors and electrical conductors, are of considerable importance. Welded joints are preferable, and as there has been considerable difficulty experienced in the welding of resistor elements, the procedure, which has been tried successfully in practice and outlined elsewhere can be followed to advantage.

As previously stated the method of supporting resistor elements has a marked influence in producing or protecting the element against hot spots, other than those which are caused by some inherent defect in the material.

In general it is usual to support the elements either on the refractor lining of the furnace, or by means of specially grooved refractor blocks, and many designs for these supports have been patented.

Some examples of refractor supports area given in Figs. 6, 7. 8 for unmuffled furnaces and Fig. 9 for muffle furnace. The principal objections to the use of the refractor, for supporting the heating element are as follows :

(1) Heat cannot radiate from the surface of the element in contact with the refractor. This contact surface becomes hotter than the remainder of the resistor which is free to radiate, thus limiting the heat which can be radiated per unit area of resistor surface without causing over-heating of the non-radiating surface. This local over-heating is increased if, in an endeavor to increase the total radiating surface, the area of contact is diminished. Again we come up against the trouble problem of local hot spots and there is always a danger of these developing at the points of contact with the refractors.

(2) Possible interaction between resistor and refractors with resultant failure : when nickel-chromium alloy elements are in service in contact with refractors containing free alkalies, then action may be set up between the element and the alkalies of the refractors, which results in corrosion of the metal. At points of attack the section of the metal is naturally thinned and again failure will occur at these points, due to over-heating. Such action can, of course, be avoided by choice of suitable refractors.

With a view to overcoming the aforementioned objections, methods have been devised for supporting the resistors by means of hooks of the same alloy as the resistors. Fig. 10 shows the GE method and Fig. 11 the Birlec method.

As will be seen, from these illustrations, by so supporting the resistor elements, direct contact with the refractors is avoided and better radiation is made possible. Further, a more rapid rate of heating may be employed with considerable less risk of overheating.

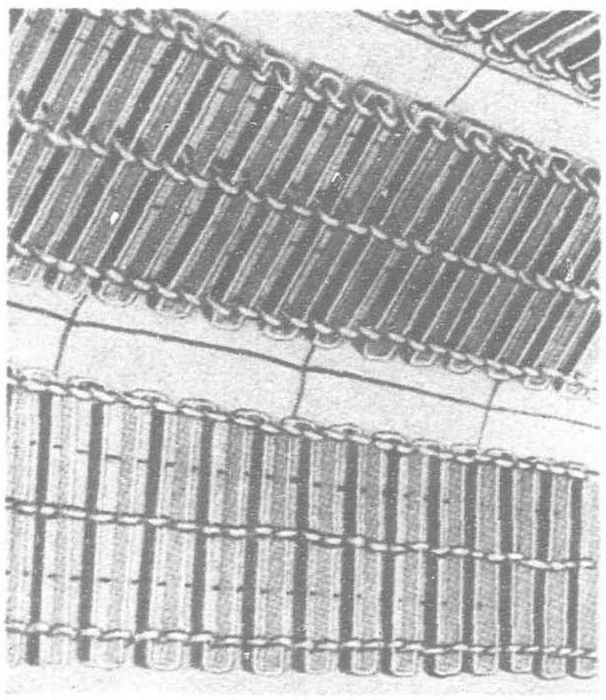

Fig. 11

The following objections to this arrangement might be raised :

(1) Difficulty of replacement if failure did occur. The use of numerous metal supports makes replacement a lengthy operation. While this may be true, it must be remembered that with modern high grade nickel-chromium alloys failure due to simple oxidation rarely occurs. Long life of resistors supported by metallic hooks would, therefore, be anticipated.

(2) Possibility of damage to the resistor from accidental contact with the charge, operating tools, etc. With this open type of resistor such damage is more liable to occur than with elements set in refractor formers. Adequate protection can be easily arranged for by provision of cast grids or guards between the charge and the resistors. Such guards do not appreciably retard the radiation of heat to the charge.

Resistor Calculations

The amount of heat which a unit area of the resistor surface can radiate depends upon the absolute temperatures of the resistor and of the furnace. The calculation of this rate of energy transmission is somewhat complicated, and Trinks* prepared a curve, as shown in Fig. 12, which serves every practical purpose. The relation between the maximum safe temperature of the resistor and the temperature of the furnace, and the rate of heat transferred from a square foot of a resistor covered wall surface, is given in Table†.

In given conditions the heat emission and carrying capacity of wires and ribbons can be calculated with great accuracy, but for convenience most of the manufacturers of electric resistance elements have published tables which tabulate the values for many possible combinations of resistor temperature and furnace temperature. Most of the tables presented by makers of resistance elements are determined by actual experiment, based upon Joule's Law and Ohm's Law. Various examples for resistor calculations are given by Trinks and by Wilcox. But for the purpose of this paper, the scope of which covers the economy which is to be obtained by the use of the heavier resistor elements, the calculations for voltage and resistor dimensions only will be considered.

* W. Trinks, Industrial Furnace, John Wiley, 1926, Vol. II, pp. 136-146.

† W. Trinks, Industrial Furnace, John Wiley, 1926, Vol. II, p. 147, Table 15.

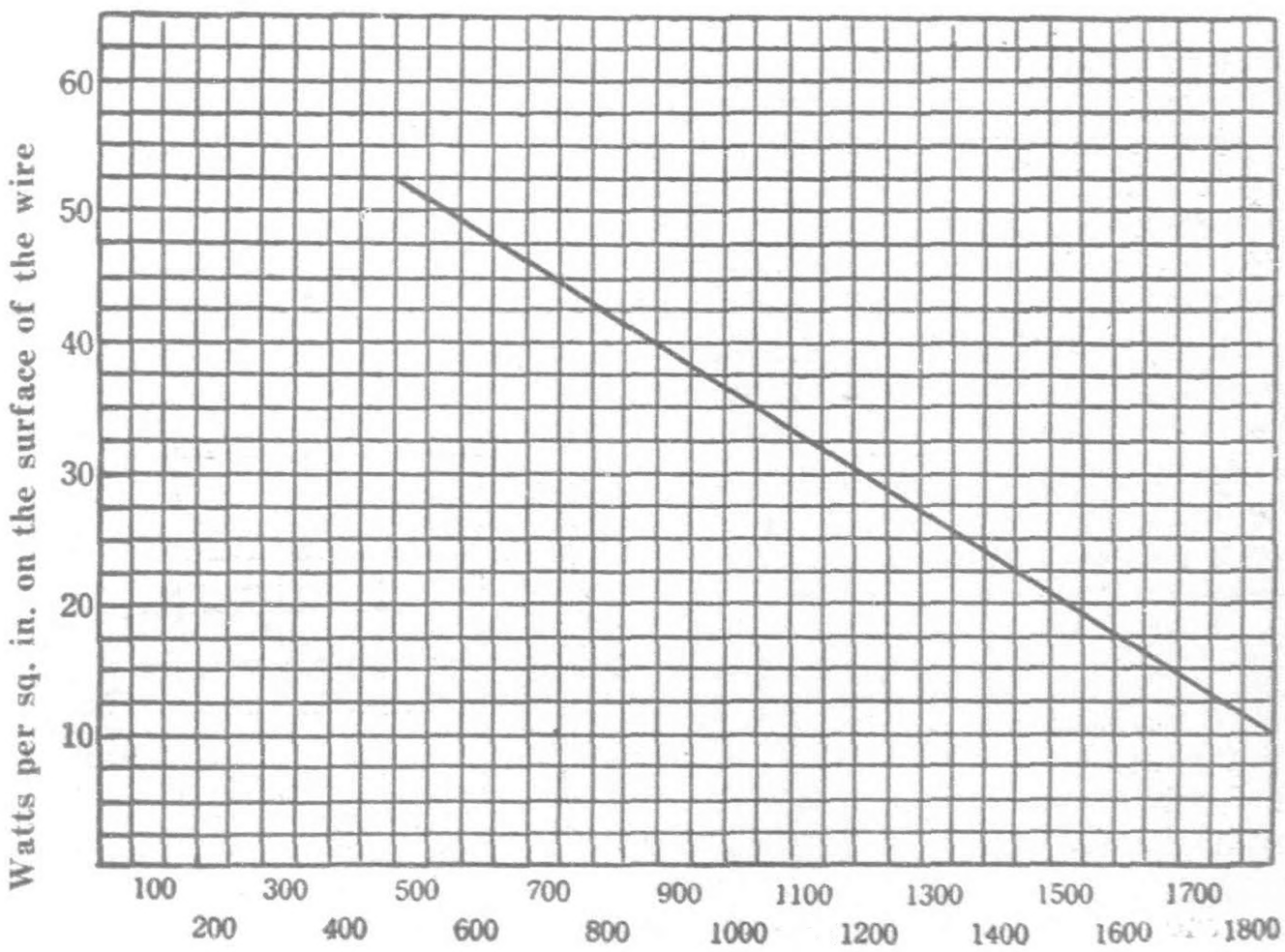

Fig. 12.—Curve showing relation between furnace temperature and safe values of heat emission from resistors. Applies to heating elements fully exposed to furnace chamber with no muffle or other interference.

TABLE V.—IDEAL RATE OF HEAT TRANSFER FROM ONE SQUARE FOOT OF ELECTRICALLY HEATED WALL

Furnace temperature, Degree F	*Temperature of resistor-Degrees F.*					
	1600	*1700*	*1800*	*1900*	*2000*	*2200*
1200 ..	4.6 kw.	5.8 kw.	8.1 kw.	10.3 kw.	12.7 kw.	18.7 kw.
1300 ..	3.8	5.3	7.2	9.5	11.8	17.3
1400 ..	2.7	4.4	6.2	8.3	10.7	16.7
1500 ..	1.4	3.2	5.0	7.2	9.6	15.5
1600 ..	0	1.7	3.5	5.8	8.2	14.0
1700 ..	—	0	1.9	4.1	6.5	12.4

Wilcox gives, as a summary of the results of calculations for nickel-chromium resistors for a 10 kw. furnace operating at 1800° F. and with the watts not to exceed 10 or 12 watts per sq. inch in Table VI.*

TABLE VI.—NICKEL-CHROMIUM RESISTOR DATA FOR A 10 KW. FURNACE

(1800°F. Element Temperature)

Energy supply and connections	*Type and size resistor*	*Watts density per square inch*	*Length in feet*	*Feet per pound*	*Pounds total weight*	*List price per pound*	*Cost of heating element, dollars*
220-volt, single-phase	No. 4 wire	4.24	306.3	8.65	35.41	4.05	143.41
	No. 8 wire	17.0	121.0	22.0	5.5	4.05	22.08
	No. 6 wire	8.4	194.4	13.7	14.19	4.05	57.47
	No. 7 wire	**11.95**	**153.65**	17.4	**8.83**	4.05	**35.76**
110-volt, single-phase	No. 2 wire	8.34	123.5	5.4	22.87	4.05	92.62
	No. 1 wire	5.9	155.1	4.32	35.9	4.05	145.39
	No. 3 wire	**11.87**	**97.19**	6.88	**14.13**	4.05	**57.23**
220-volt, three-phase, star-connected ..	No. 10 wire	**11.3**	**231.3**	34.7	**6.67**	4.17	**27.81**
220-volt, three-phase, delta-connected ..	No. 13 wire	**10.7**	**341.1**	69.5	**4.95**	4.41	**21.83**
220-volt, single-phase	Ribbon, inch						
	No. 28 by $\frac{1}{2}$	13.7	59.4	44.2	1.34	5.80	7.77
	No. 23 by $\frac{1}{2}$	7.48	106.6	24.4	4.37	5.10	22.29
	No. 26 by $\frac{1}{2}$	**10.8**	**75.0**	34.7	**2.13**	5.50	**11.72**
	No. 24 by $\frac{1}{2}$	8.5	94.2	27.5	3.43	5.20	17.84
	No. 22 by $\frac{3}{8}$	**11.6**	**8.95**	29.5	**3.03**	5.05	**15.30**
	No. 34 by $\frac{3}{4}$	**12.4**	**44.5**	59.8	**0.744**	7.20	**5.36**

Wilcox† points out that: In Table VI, "Each of the 15 resistors considered would dissipate 10,000 watts of heat energy in the heating chamber, with the power supply as specified in the table. The figures in bold type are more nearly comparable because they apply to resistors operating at approximately the same watts densities.

"Referring to the fourth column, it will be noted that the resistors vary from 44.5 to 344.1-ft. in length for approximately the same watts densities and dissipating the same amounts of energy. The sixth column indicates that the total weight of resistors vary from 0.744 to 14.13 lb., respectively, for approximately the same watts densities. The last column shows that the costs of the resistors, based on list prices of nickel-chromium, vary from $5.36 to $57.23 (1928 prices) for practically the same watts densities and identically the same total watts capacity."

From the present practice in Japan it is obvious that the Japanese designers would adopt the resistor which showed the lowest first cost. In the following paragraphs the present writer will endeavor to show that such practice is not the most economical.

That the mechanical strength of resistance materials has an important effect on the life is shown by the studies by Asaki.‡ The importance of mechanical strength is shown by Fig. 1 in the aforementioned studies, which indicates that the material with the greatest mechanical strength gives superior service on a four hour and 24 hour test.

If the life of a resistor is influenced by its mechanical strength, and if mechanical strength increases for a given element in proportion to the area, then it is reasonable to assume that the larger the area obtainable in a resistor element for a given load the greater should be the life. Naturally, failure of resistors due to other than mechanical causes cannot be avoided by such a simple expedient as an increase in the cross sectional area of the resistor although the operation at a lower wattage consequent to the larger area might even favor chemical weaknesses. It must be borne in mind that the life of a resistor cannot be determined by merely increasing its cross sectional area. It is obvious that if this could be done there would be no need for the various experiments of Mr. Horioka, *et al.* Even Mr. Horioka's experiments, exhaustive and dependable as they were, did not disclose a correct formula for determining the life of a resistor.

What the present writer wishes to show is that the useful life of a resistor can be prolonged, as far as break-down from mechanical causes are concerned, by using resistors of large rather than small cross-sectional areas. That this has been proved in practice is borne out by the opinions already cited from Trinks and Wilcox as well as by the writer's observation in America and England.

The writer has attempted to show the measure of economy of this empirical truth mathematically, in the following manner:

Comparison Between Life and Price of the Two Resistance Wires

For the convenience of calculations, at the beginning, we assume the following: 500 watts of electrical energy should be dissipated at a temperature of 1,800° F. from each of two different heating wires of 20-ft. length. The material in the wire is also assumed to be Nichrome IV.

We proceed to determine the wire size based on the above assumptions.

As the wire size is variable according to its watt density, we also assume the watt density as 10W/sq. in. for heavier wire and 20 W/sq. in. for the lighter one.

The calculation for determining wire size is carried out by the method presented by Wilcox.§

The process of calculation is as follows:

For heavier wire 10 watt per sq. in.

$$\frac{500\text{W}}{10\text{W/sq. in.}}=50$$

50 sq. in. of surface area is required to dissipate 500 watt energy.

$$\frac{50\text{ sq. in.}}{20}=2.5\text{ sq. in.}$$

2.5 sq. in. of surface area is required for unit length of the wire. From this value we can easily find the size of wire. The equivalent size of 2.5 sq. in/ft. is B. S. No. 14.

B. S. No. 14 wire of Nichrome IV has a resistance of 0.153 ohms per ft. and its temperature coefficient at 1,800° F. is 1.034, therefore the resultant resistance is

$$0.153\times1.034=0.158\text{ ohm/ft.}$$

*Edgar A. Wilcox, McGrew-Hill Book Co., Inc., N.Y., 1928, Electric Heating, p. 81.

†Edgar A. Wilcox, Electric Heating, p. 80.

‡Design of Electric Heating Devices. By I. Asaki, *Japan Nickel Review*, October, 1933.

§Electric Heating, Edgar A. Wilcox, McGraw-Hill Book Co., Inc., N.Y., 1928, p. 83.

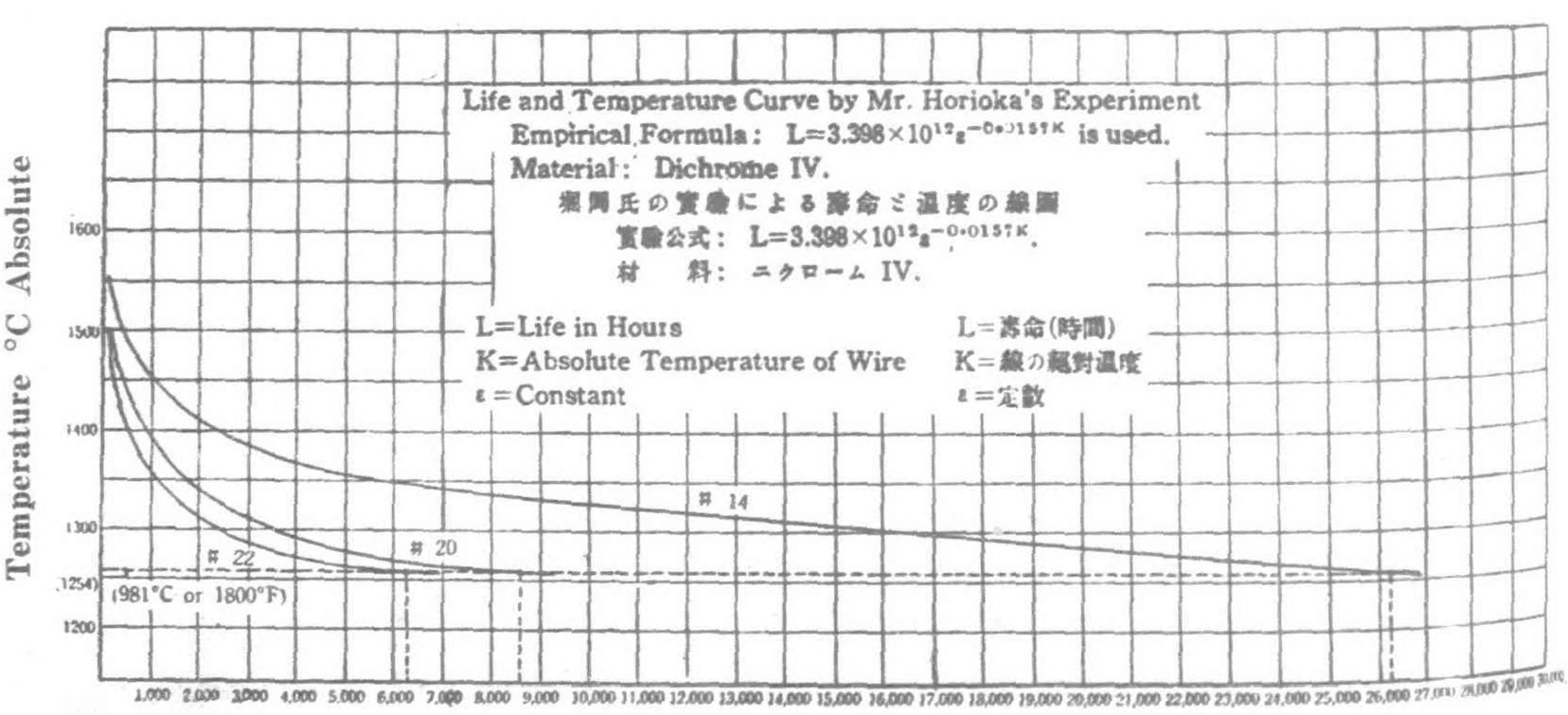

Fig. 13.—Life in hours

The total resistance for 20-ft. length is $0.158 \times 20 = 3.16$ ohms. Therefore total voltage drop is as follows :

Let E=Voltage Drop
W=Total Watt Consumed
R=Total Resistance

then

$$E = \sqrt{WR} = \sqrt{500 \times 3.16} = 38.7\text{-volts}$$

If we reasonably assume the price of this wire to be Y.4.50 per lb., the price of 20-ft. is

$$\frac{1}{88} \times 20 \times 4.50 = \text{Y}.1.03$$

Analogous with the above calculations, we can easily obtain the size of the lighter wire which should be subjected to the watt density of 20 W/sq. in.

The result shows that No. 20 wire of 20-ft. length is required to dissipate 500 watt energy at 1,800° F. and its voltage drop is 70.2-volts.

If we reasonably assume the price of this wire as Y.8.50 per lb., the price of 20-ft. length is

$$\frac{1}{352} \times 20 \times 8.50 = \text{Y}.0.50$$

On the other hand, the life value of the above two wires, i.e., of No. 14 and No. 20, can be estimated by applying Mr. Horioka's* empirical formula $L_2 = 3.398 \times 10^{12} e - 0.0157K$ for Nichrome IV. From the results of Mr. Horioka's experiment, I have drawn a life and temperature chart (Fig. 13) for Nichrome IV wire of No. 22 size and by extrapolating the results to the present two wires, we get the life and temperature curves for No. 14 and No. 20 wires respectively.

As the temperature in this case is 1,800° F. or 981° C. or 1,254° C. in absolute scale, we can easily estimate the life value of No. 14 wire as 26,300 hours and of No. 20 as 8,700 hours.

Summing up all of the foregoing we conclude that to dissipate the same quantity of energy at the same temperature the heavier or No. 14 wire requires about 0.23 lbs. in weight or about Y.1.03 in price, while for the lighter or No. 20 wire, it requires about 0.057 lbs. of wire or Y.0.50 in price.

On the contrary, if we take life values into consideration, the former will endure about 26,300 hours while the latter will endure about 8,700 hours.

This means that the price increase for heavier wire is about 100 per cent while the life increase is about 200 per cent.

$\hat{c}$=current density r=radius of wire
Q=heat evolved R=resistance in unit length

$\pi r^2 . \hat{c}$=total current=I

$$I^2 = \frac{Q}{R} \ldots\ldots \text{Joule's law}$$

$$\pi r^2 \hat{c} = \sqrt{\frac{Q}{R}}$$

$$\text{or } (\pi r^2 \hat{c})^2 \, R = Q$$

Calculation Based on Wilcox's Method

Assumption :—

500 watt at 1,500° F., length 20-ft.

When watt density is 10 W/sq. in.

$$\frac{500}{10 \text{ W/sq. in.}} = 50 \text{ sq. inch.}$$

$$\frac{50}{20} = 2.5 \text{ sq. in/ft.}$$

B.S. No. 14 0.153 ohm/ft.

$0.153 \times 1.034 = 0.158$

$0.158 \times 20 = 3.16$ ohm total length

$E = \sqrt{500 \times 3.16}$

$= 39.7$-volt

Price Y.4.50/1 *b*, for No. 14 wire (say)

$$\frac{1}{88} \times 20 \times 4.50 = \text{Y}.1.03$$

When watt density 20 W/sq. in.

$$\frac{500}{20} = 25 \text{ sq. inch}$$

B.S. No. 20 0.61 ohm/ft.

$0.61 \times 1.034 = 0.631$

$0.631 \times 20 = 12.62$

$E = \sqrt{500 \times 12.62}$

$= 79.4$-volt

Price Y.8.50/lb.

$$\frac{20}{352} \times 8.50 = \text{Y}.0.50$$

Price increase is about 100 per cent
but Life increase is about 200 per cent
Economy factor besides cost of resistor

(*a*) Postponed replacement
(*b*) Saving the loss of production during replacement.

*Mr. Horioka *et al*, Report of Electrotechnical Laboratory, May, 1931, p. 14, Table IV.

Ceylon's Engineers Organize

At a largely attended meeting at Colombo in November presided over by Mr. C. J. D. Lanktree, Manager of the Ceylon Government Electrical Department, and composed of Electrical Engineers of the Municipalities and U.D.C's, and contractors in Colombo and outstations, it was unanimously decided to form an Electrical Development Association.

A Provisional Committee, with Mr. Lanktree as Chairman, and composed of three members representing contractors, three members representing Municipalities and Urban District Councils and three members representing the Government Electrical Department, was appointed to draw up a constitution to be considered at a subsequent general meeting.

Mr. Lanktree, in explaining the object of the meeting, said that at present they had in Ceylon a number of people interested in electricity, such as the supply authorities, electrical contractors, electrical engineers, and others. As far as he could see, they in their own little way had done a certain amount of good but they had, to his mind, not been progressing as they should have done. They had called that meeting with the object of trying to get together everybody who was interested in the development of electricity, it did not matter how they were interested. By their combined efforts they should be able to do something, not only to develop electricity in the Island as a whole, but incidentally help each other as well.

There was the desirability of having some central organization which could deal with contentious technical points, discuss them, and, if necessary, when called upon, improve them. There was the question of combined advertising, the formation of a technical reference Library, and the possibility of the more senior members being able to help the younger members of the profession, such as by a series of lectures on more technical matters and last but not least they would be able to do quite a lot in cultivating an "esprit de corps" among members of the profession, whereby they could do much to raise its standard.

Mr. Lanktree then proposed from the chair "That in the opinion of this meeting it is desirable that an Electrical Development Association should be formed in Ceylon."

The motion was seconded and carried.

Mr. Lanktree next dwelt on what he thought should be the functions of the Association. So far as his own department was concerned he thought it must definitely be advisory and must deal with possible methods of development. The main object of the Association should be to increase consumption of electricity in Ceylon and improve the standard of contracts to ensure a good standard of work, and generally raise the standard of installation work.

Engineering Notes

INDUSTRIAL

CANTON'S SUGAR FACTORY.—Preparations are under way to establish a sugar factory in Suncho village, near Canton, following the appointment of an American expert. The machinery for the plant has been ordered from Honolulu.

NICKEL PRODUCTION IN JAPAN.—The Japan Iodine Company plans to produce nickel to meet one-half of Japan's total demand of 3,000 tons. The company has selected a factory site in Hiroshima, and will send half-finished articles to its Yokohama factory for finishing. The daily output will be five tons. A Japan Nickel Information Bureau was recently founded to distribute reports regarding nickel and nickel alloys among Japanese by the International Nickel Company.

CAPITAL OF MANCHURIA.—A total of $20,000,000 is proposed to be spent in construction work in Hsinking, capital of Manchoukuo. The Government is spending $1,500,000 on public buildings, $900,000 on roads, $600,000 on water mains, $400,000 on sewerage, and $200,000 on parks and athletic fields. The Kwantung Army is spending $2,850,000. The Kwantung Government is building a new post office, other public edifices and residences for officials, costing altogether $660,000. The S.M.R. Co. and others are devoting nearly $9,400,000 on building work. Schools, new police stations, larger telephone and telegraph offices, and other items are estimated to cost $2,000,000.

PLANT IN MANCHURIA.—The Japanese Government has granted a permit to the South Manchurian Railway Co. for the establishment of a sulphate of ammonia plant at Dairen. The name of the company is to be the Manchurian Industrial Chemical Co., Ltd., or the Manchu Kwagaku Kogyo, K.K. The capital is to be Y.25,000,000, one-half to be paid by the South Manchurian Railway Co. and the other half to be offered for general subscription to the public. The plant is to provide an annual capacity of 180,000 tons of sulphate of ammonia, but full production will not be reached for some time after the opening of the plant, which, it is anticipated, will be about the middle of this year. At the opening of the plant, the production will be at the rate of 90,000 tons per year.

ALCOHOL DISTILLERY.—The contract for machinery for a proposed alcohol distillery for Shanghai has been awarded to the American Trading Company. The capacity will be 5,000 gallons of highly rectified spirit per day, of a quality conforming to the standard of the British Pharmacopœdia, and the plant will be designed to facilitate doubling the output at any time. The equipment will be of the most modern construction, with all the latest improvements, and will be shipped from British ports immediately. The distillery will be located on a deep-water river frontage, which has been acquired for the purpose. The enterprise is jointly financed by the National Government, private Chinese and overseas Chinese capital, and the plant will be in full operation in about eight months' time.

MINING

FINDS COAL BED.—A large coal bed is believed to have been discovered at Hsiaokiangtsutzu half a mile to the north-east of the railway town of Ssupingkai between Changchun and Mukden.

The seam was found accidentally while a Japanese was engaged in sinking a well.

The discoverer has applied for mining rights over 18,000 square feet of land.

The coal is said to be of exceptionally fine quality.

COMMUNICATIONS

TELEPHONES FOR KIANGSI.—Kiangsi Provincial Government proposes to carry out at an early date a net of long distance telephone throughout Kiangsi province along the lines of highways completed or in progress of construction.

TRAMS FOR CANTON.—It is reported that the Government of Canton intends to construct two tramway routes that will cut across the city from east to west. The materials, which will cost nearly £400,000, are to be purchased from England.

NANKING TELEGRAPH ADMINISTRATION.—The Nanking Ministry of Communications is considering plans for a new ten-storey building for the Telegraph Administration to be erected next year. So far no information has been received from Nanking in this connection, but it is definite that the proposal will be executed.

TUNNEL FOR CHIEN TANG ?—The proposed bridge across the Chien Tang River is still held up, as another plan for excavating a tunnel is now being pushed by some in the Reconstruction Bureau. It is said that the borings show the under-river strata to be just right for such, and that, instead of spending $5,000,000 on a bridge, the tunnel could be built for a fifth of the sum.

HONGKONG AIR PORT.—After receiving detailed explanation of the proposed development of the Kai Tak aerodrome as a fully equipped air port capable of dealing with air mail service, Hongkong Legislative Council approved of the construction of a civil hangar and slipway and the raising and regrading of the western area of the Air Port at an estimated cost of $800,000, to be charged to a loan. A sum of $520,000 is to be spent during ohe financial year 1933 from the surplus balances tf the Colony.

ELECTRICAL

PLANT FOR TUNGCHOW.—An electric light plant is being erected on the Yangtze, a few miles from Tungchow City. Being on the river it is easy to ship in coal and oil. The plant is near the industrial part of the Tungchow district, and will be large enough to supply all the neighborhood for several miles in each direction with electricity.

POWER PROJECTS IN JAPAN.—The Yahagi Power Company has commenced work on a new 66,000 kw. power at Taifu, and the Kwansai Kyodo Steam Power Company is increasing the capacity of its plant from 50,000 kw. to 150,000 kw. The Tokyo Electric Light Company is to construct fourteen power stations on the Tadami River in Fukushima-ken at a cost of approximately Y.88,000,000.

JAPAN POWER PROJECTS.—A message from Yokohama states that the I.G.R. is considering harnessing the waters of the Titsu River and the erection of two 50,000 kw power stations at a cost of Y.10,000,000. There is also a scheme afoot for additional projects on the Shinano River, as about 25,000 kw will be required on an electrified railway from Suita to Akashi and Otsu. The railway authorities are to undertake the development of the Tenryu River and propose to erect two 50,000 kw power stations at an estimated cost of Y.20,000,000. A 24,000 kw power station is also to be erected on the Jiniyoda River, the work being undertaken by the Sutitomo Company. The I.G.R. are electrifying the Uyeno-Abiko section of the Joban line, for which the cost will be about Y.900,000. The work of construction will be started at the end of the current fiscal year, and it will take about a year to complete.

TOKYO POWER STATION.—A steam-power station of 100,000 kw. is to be erected by the Tokyo Electric Light Co. at a cost of Y.10,000,000.

TOKYO ELECTRIC.—Tokyo Electric Light Co. is contemplating extending the capacity of its Tsurumi thermal power station from 100,000 kw. to 300,000 kw.

ENTERPRISES IN CHINA.—The Nanking Political Council has approved in principle the proposal of the National Construction Commission for the issuance of an additional loan of $6,000,000 for the development of electrical enterprises.

POWER LINE FOR NAGOYA.—The Yahagi Hydro-Electric Power Co., affiliated with the Daido Electric Power Co., has decided to erect a new power transmission line between Inuyama and Nagoya, Japan. This line is to supply power to Nagoya and will be under 77,000-volts.

RAILWAYS

YUSHU-PINGHSIANG RAILWAY.—The Finance Commission of Kiangse has issued a domestic loan of $200,000 for completion of the Yushu-Pinghsiang railway, to connect the two provincial capitals of Nanchang (Kiangse) and Changsha (Hunan). When the railway is completed, there will be through transportation to Changsha from Kiukiang via the Nanchang-Kiukiang line.

NEW RAILWAY IN KIANGSI.—Prof. Hsiao Shun-ching, chairman of the provincial economic council, states that next spring he expects to start work on a railway across Kiangsi to link up with the Chekiang and Honan systems. It is estimated that the cost of construction will be $20,000,000. The line will be 570 kilometers in length. The rails are to be of 60 pound weight. Construction of the Eastern section will be undertaken by the Chekiang railroad and run in connection with their system until the link has been made with Nanchang.

MANCHURIAN RAILWAY EXPANSION.—A sum of Y.60,000,000 (£3,750,000 at present rates) has been set aside for new enterprises during the coming business year by the directors of the South Manchurian Railway Company. Purchases of rolling stock and general expansion of business will take Y.29,500,000 (£1,843,750) of this money, Y.14,500,000 (£906,250) has been allotted to the Fushan Collieries, while expenses in connection with harbor and railway construction projects in North Korea account for Y.6,800,000 (£425,000). The railway company is reported to anticipate a net profit of £2,560,000 from the coming business year.

STATION FOR SHANGHAI.—Plans drafted for construction of the station to accommodate the headquarters of the Shanghai-Nanking and Shanghai-Hangchow Railway Administration in place of the North Station which was partially destroyed during the Sino-Japanese hostilities will call for a total outlay of $10,000,000. A vast piece of land near the railway station at Chenju has been chosen. The first work will be the main building to accommodate the Administration, the station platform and other offices. The railway tracks, a small railway workshop and the godown at Markham Road will then be carried out. Plans have also been made for the removal of the central factory where repairs to locomotives and construction of engine parts are made from Wentsaopang to the new central railway station at Chenju. The construction of this factory will be proceeded with slowly. A large part of the funds required for the preliminary construction is already available.